THE

ELECTRICAL REVIEW.

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THE

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1901 Edition

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GERMAN AND BRITISH SYSTEMS OF TECHNICAL EDUCATION.

SCARCELY a public speaker of recent times, when referring to the severe competition experienced by manufacturers in this country from abroad, has failed to blame our secondary and technical education as being responsible to some extent for allowing foreign competitors to overtake us in many industries in which we formerly had the field to ourselves. Some truth, no doubt, exists in this assertion, though other causes are also at work.

In the *Monthly Review* of July last, Mr. J. B. C. Kershaw has contributed an interesting article on this subject, in which the chief points of difference between our system and that in vogue in Germany are clearly set out. As the German system of secondary and technical education has during recent years been put forward as one more advanced and more carefully adapted to commercial requirements than our own, it is interesting to see where it differs from our own, and to ascertain whether the advantages claimed for this system apply to the electrical industry to the same extent as they do to other industries.

The chief difference between technical education as practised in Germany and as in vogue in this country, is best defined by quoting Mr. Kershaw's own words:—

> The chief features of the German system are centralisation and thoroughness; of the English, expansiveness and shallowness.
>
> The German aim has been to educate all who are to occupy *posts of position* in manufactures and industries, thoroughly; the English aim, in so far as there can be said to have been any aim, has been to educate the *rank and file* of the workers, badly.
>
> . . . . The technical schools or polytechnics are much less widely scattered in Germany than is now the case in England. Those that exist are, however, much more thoroughly equipped for their special work, and have a much larger number of teachers and professors attached to them than is the case in this country. It has apparently been recognised that it is useless and absurd to give a thorough technical training to the whole population, and therefore there has been no attempt to erect a polytechnic in every town of the slightest manufacturing or industrial importance.

The aim in Germany has seemed to be for certain colleges to specialise in certain subjects, thus enabling students who wish to take a regular course in some particular subject, be it agricultural science, dyeing, art, or engineering, to choose from a limited number of colleges that afford the best training possible in that particular subject.

It is no doubt in some ways useful to have technical colleges scattered about the country, in almost every town, and to be able to offer opportunities to the masses for cultivating their tastes and increasing their knowledge during the winter months, but it is questionable whether the industries of the country will see much practical return for the public money necessary to maintain such institutions.

There can be little doubt but that a mistake is being made in this country in allowing every small town to boast of its own college, thus necessarily giving only a superficial training to many, whereas if the powers and capital, at present spread over many colleges, were concentrated in a

more limited number, a more thorough course would be available for those that were enabled to follow it.

The point, however, seems to be whether the education of an electrical engineer can be best met by enabling him to attend lectures, and work in the laboratories in the evenings, after his day's practical work is over, or by affording him a regular technical course on electrical engineering and its allied subjects, extending over some two or three years spent at a technical college. It may appear, at first, that the latter is undoubtedly the best plan, but for the following reasons one cannot help thinking that this may not necessarily be the case.

The necessary practical training of an electrical engineer is lengthy, amounting to some five years divided between the shops of mechanical and electrical manufacturers; consequently, another two or three years added to this will be longer than the average student can afford to spare, more especially if he has remained at school till the age of 18 or 19, which part of a boy's education many parents rightly do not care to curtail.

Consequently, it resolves itself into the question whether the practical training should be curtailed in order to allow time for the technical course, or whether the practical training should be left undisturbed, and arrangements made for acquiring technical knowledge during this period.

To those students who at this stage of their life can afford a few years for college life, and there are many who can, without the fear of having to curtail their subsequent workshop training, a few colleges that could offer a thoroughly sound technical course in electrical engineering and its allied subjects, would be of great utility.

It is to be feared, however, that the majority of students would have to curtail their practical work in the shops, if a two or three years' college course were laid down as imperative for an electrical student to follow.

For these, evening lectures should be provided in the chief engineering centres in this country, the lectures being of as thorough a nature as possible.

Such an arrangement does not seem to be included in the German system, and its omission would appear to be a weak point.

The electrical profession is an exception, due to the student having first to qualify as a mechanical and then as an electrical engineer, a proceeding which, naturally, takes time—a thing which the German system of technical education seems to overlook, at least, so far as the turning out of practical engineers is concerned.

To quote again from the article :—

> Two changes will be necessary in this country before our systems of technical education can be held to be giving satisfactory aid to our manufacturing industries. There must be, first of all, concentration upon a few technical colleges, of the energies and funds now spread over many; and there must be, secondly, greater appreciation on the part of our manufacturers themselves of the part that science plays in the economical conduct of their business. But, given the facilities for obtaining a deep and thorough training in technical science equal to those found on the Continent, could we promise to the students who devote two or three years to such a study, that they would, under the present conditions, easily find employment in this country? I am afraid not. . . . . Devoid of all scientific training themselves (viz, the manufacturers) they naturally undervalue it in their subordinates, and the majority of them have yet to grasp the fact, so clearly seen by our German rivals, that the best possible training for industrial posts is one in which the practical experience is based upon a broad and thorough training in general science.

The idea cannot seriously be entertained that manufacturers would not readily avail themselves of the services of men who had acquired a thorough scientific training, provided the practical side had not been omitted. But, due to the difficulties enumerated above, the practical side seems in many cases to be omitted in Germany, judging by many who come over here ostensibly as fully qualified engineers. These men are often scientific and learned, but in many cases their much learning has not taught them the quickest way to make a simple calculation or to apply their knowledge to practical work. This could all be remedied by a subsequent practical workshop training, but in many cases German students are obliged to curtail this for want of means.

It would seem to be a question whether the industry as a whole would benefit by manufacturers taking students who had been through a college course with possibly a short workshop experience, and at their own expense completing their practical training.

If this is impracticable, however, for the sake of those who wish to learn as much as possible about the theoretical side of the business in the evenings whilst serving their time in shops during the daytime, one would be sorry to see the evening classes abolished in the colleges of our more important towns—rather let them be raised in standard, to facilitate the theoretical and practical training being attained at the same time.

Those who can afford a few years given up entirely to a technical college course, without having subsequently to curtail their worshop training, should, however, be offered facilities for attending such a course at a few special colleges in the country.

At present, in view of the more thorough nature of the German colleges, a student could do worse than kill two birds with one stone by going through the course at one of these institutions, thus ensuring as good a technical education as can be obtained anywhere, and at the same time mastering a foreign language, the advantage of which the average Britisher too often despises.

Let us follow the Germans in strengthening the colleges in our more important towns and cities, but let us step in front of them by offering every facility in the way of evening courses to those who are obliged to limit their training to, say, five years.

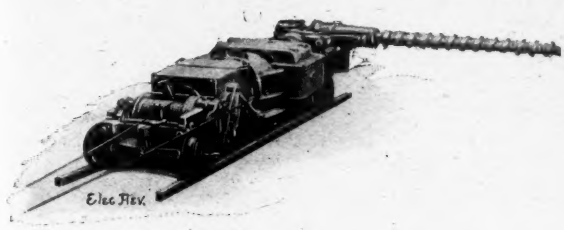
High-speed Trains.—"M.I.C.E.," writing in the *Times*, makes some observations regarding high-speed travelling on a Pennsylvania Railroad train between Philadelphia and Atlantic City. The line is ballasted on the same system as the permanent ways of our main lines in England. The rails are 100 lbs. to the yard in 60 ft. lengths. No grade exceeds 1 per cent., and the sharpest curve is not over one degree, the cars being on six-wheel bogies. The distance run was 52 miles, and the average speed 76·8 miles per hour. The writer says that he was impressed with the absolute smoothness of the running, and is of opinion that the train could have been run at the rate of 100 miles per hour with the same comfort; he is convinced that this result can only be obtained, and the danger from extreme oscillation obviated, in high-speed trains, by allowing such trains to be run only on railroads built on the lines of those indicated above.

GLASGOW INTERNATIONAL EXHIBITION, 1901.

VIII.

MESSRS. MAVOR & COULSON (*continued*).

High Speed Triplex Pump.—This pump is of Messrs. Merryweather & Son's well-known "Hatfield" type. The pump is entirely of gun-metal; the three barrels are arranged symmetrically round the crankshaft, and the valves are easy of access. The pump runs at 300 revolutions per minute, and with the motor to which it is coupled will deliver 222 gallons of water per minute against a head of 50 to 60 ft. The motor is of the enclosed type, and is

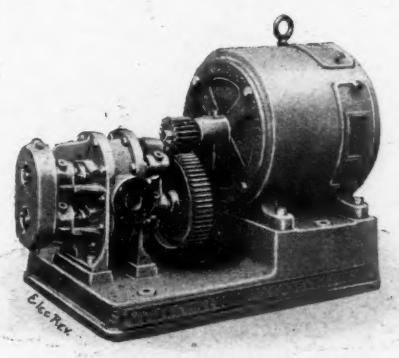


ELECTRICAL COAL-CUTTING MACHINE.

carried upon a combination base together with the pump. The field coils are formed, and are held on by polar extensions. The brush spindles are bolted to the end plate of the cover, initial adjustment being provided for by oval holes. For lubrication wick rings are used, as these do not require so large a space for their introduction as metal rings.

Combinations of this class have been supplied for a variety of services, including boiler-feeding, fire service and water supply for country houses, &c. This pump and motor are shown in action.

Rotary Pump.—The pump is of the Drum Engineering Company's make, and consists of a revolving piston sweeping out the cylinder at every revolution, and dipping into a revolving valve or cylindrical drum, the openings to which are so arranged that the piston passes through without slip, back pressure or undue friction. When the revolving piston moves round from the revolving valve a vacuum is formed

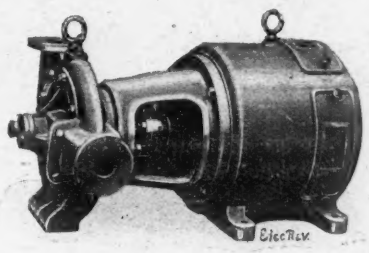


ROTARY PUMP.

into which the water, oil or other fluid flows and is forced in front of the piston. This pump is specially adapted for dealing with oil or other viscous fluids. The pump makes about 250 revolutions per minute, and is driven by a machine-cut cast-iron spur-wheel and raw hide pinion from the enclosed motor, which runs at 800 revolutions per minute.

Centrifugal Pump.—The pump is one of Messrs. Drysdale's "Bon Accord" 2-in. centrifugal pumps, having double suction, and fitted with 12-in. diameter open type brass impeller and manganese bronze spindle. The pump is carried by a flanged extension of the motor shell, and thus avoids the necessity of a bedplate. The combination is designed to deliver 4,000 gallons of water per hour to a height of 30 ft. at a speed of about 1,100 revolutions per minute. This combination is shown in action.

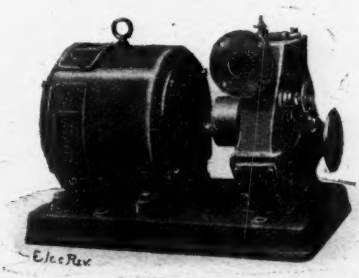
Motor and Fan.—The fan is one of Messrs. Davidson and Co.'s "Sirocco" type, designed to run at a speed of 2,100 revolutions per minute, and coupled direct to the spindle of an enclosed four-pole motor, mounted upon a steel base, which also carries the fan casing. This fan, at its normal speed, will supply air for 18 smiths' fires, and the motor is adapted for a pressure of 210 volts. These fans, it is claimed, represent a new departure in fan construction, and their volumetric capacity, relatively to their size, is extraordinary. The fan is so connected to the motor, that its angle of discharge can be adjusted to any required direction.



CENTRIFUGAL PUMP.

A similar combination is largely used for ventilation in H.M. Navy.

Electrical Coal-Cutting Machine.—This machine is of the bar type, built by Messrs. Mavor & Coulson, Limited, under Burd's patents. It consists essentially of three parts (1) motor; (2) the cutting gear; and (3) the haulage gear. The motor is arranged in the centre of the machine, and drives the cutter through machine-cut bevel wheels. The machine exhibited is of the medium size, and is arranged for an undercut of 4 ft. 6 in., but it is made in three sizes, the large size undercutting 5 ft. 6 in., and the small size undercutting 3 ft. 6 in. The cutting bar, which revolves at the rate of about 400 revolutions per minute, has a series of cutting picks fixed into taper holes upon it, and a worm being turned upon the bar it serves as a conveyor for bringing out the cuttings, thus enabling the bar to keep itself free. In addition to the forward movement given by the haulage gear, a reciprocating gear is provided for see-sawing the bar out and in the holings; this, and the provision by which



HIGH-SPEED TRIPLEX PUMP.

the bar is enabled to cut itself into the face without the necessity of having the holing begun by hand labour, are important features of the machine, which is extensively used in the English coalfields.

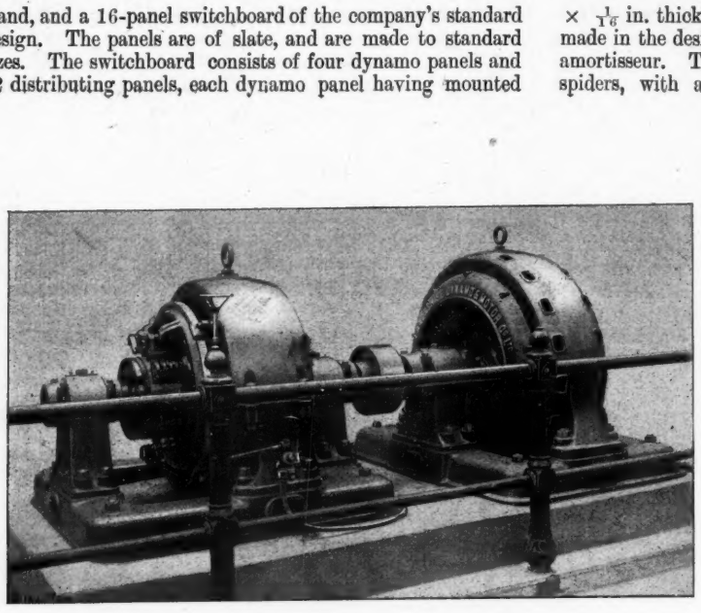
The company also exhibit specimens of their multipolar and bipolar dynamos, which are of substantial design and good finish, the excellence of the winding being a specially notable feature. A group of enclosed motors of the company's standard type is exhibited, varying in size from ¾ H.P. up to 33 H.P. These motors are all enclosed in cast-steel shells, and have fixed brush position for all loads and self-oiling bearings.

A 20-in. projector of the Suez Canal type is shown upon this

general science.

indicated above.

stand, and a 16-panel switchboard of the company's standard design. The panels are of slate, and are made to standard sizes. The switchboard consists of four dynamo panels and 12 distributing panels, each dynamo panel having mounted upon it an ammeter, an automatic switch and a shunt regulating switch, and each distributing panel a switch, fuse and ampere gauge. The panels are fixed in an angle iron frame fronted by a handsome polished brass moulding, and the whole is supported upon four cast-iron columns, thus avoiding the necessity for any woodwork in the neighbourhood of the switchboard. The circuit breakers are of the I.T.E. type, and the instruments of Messrs. Kelvin & James White's make.



Lancashire Dynamo and Motor Co.'s Motor Generator.

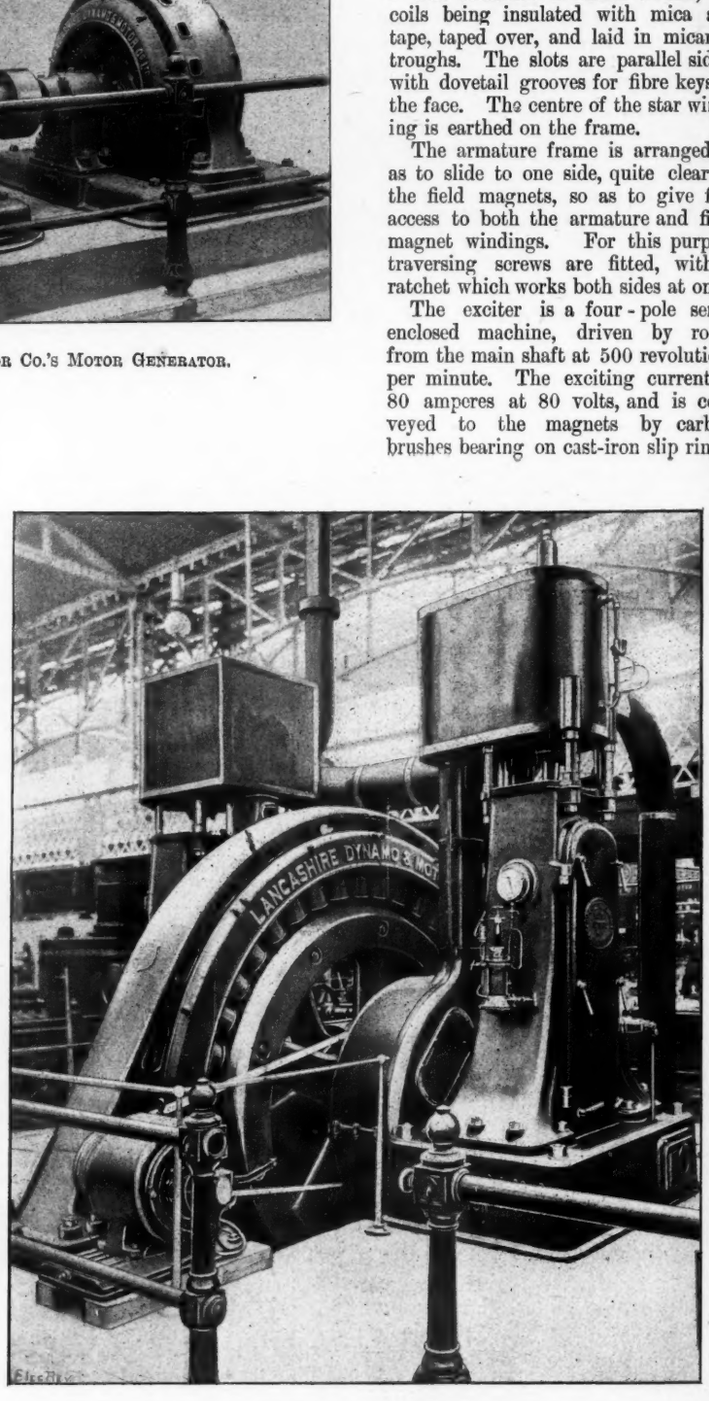
Concentric Wiring.—The company exhibit illustrations of the "C.C." wiring, which they have for many years made a speciality; starting switches, &c., are also shown.

A number of their motors are in use for providing power to other exhibitors throughout the Machinery Section.

A motor-generator, consisting of a 5-H.P. two-pole enclosed motor driving by belt a two-pole open generator, is used for supplying current to the machinery on the stand. About 120 motors of the same build have been supplied to Messrs. Vickers, Sons and Maxim's shipyard.

Lancashire Dynamo and Motor Company.

This company, which only started work last year, but has already won for itself a firm position among our leading dynamo builders, exhibits a complete power transmission plant in a small compass. The system comprises a 200-KW. three-phase alternator, working at 5,000 volts, 50 periods per second, and transmitting power to a motor-generator.



Lancashire D. & M. Co.'s Alternator and Hick-Hargreaves Engine.

The alternator is mounted on the main shaft of a Hick, Hargreaves compound engine, and runs at 150 revolutions per minute. The armature is fixed; the rotating magnet wheel is provided with 40 laminated soft-iron poles, wound with copper tape on edge, 1 in. wide × $\frac{1}{16}$ in. thick, insulated with press-spahn. Provision is made in the design of the pole faces for the addition of an amortisseur. The fly-wheel is built up of two cast-iron spiders, with a steel ring shrunk on their periphery to carry the magnet poles; the spiders are held in place on the shaft by two stout rings shrunk on the hubs, keys being unnecessary. The wheel is about 10 ft. in diameter over the poles, and weighs 12 tons with the shaft, but without the poles.

The armature is former-wound, the coils being insulated with mica and tape, taped over, and laid in micanite troughs. The slots are parallel sided, with dovetail grooves for fibre keys at the face. The centre of the star winding is earthed on the frame.

The armature frame is arranged so as to slide to one side, quite clear of the field magnets, so as to give free access to both the armature and field magnet windings. For this purpose traversing screws are fitted, with a ratchet which works both sides at once.

The exciter is a four-pole semi-enclosed machine, driven by ropes from the main shaft at 500 revolutions per minute. The exciting current is 80 amperes at 80 volts, and is conveyed to the magnets by carbon brushes bearing on cast-iron slip rings, carried on bolts sulphur-cemented into the boss of the fly-wheel.

The engine, built by Messrs. Hick, Hargreaves & Co., is rated at 450 I.H.P., running up to 190 revolutions per minute,

deliver 4,000 gallons of water per hour to a height of 30 ft.

A 20-in. projector of the Suez Canal type is shown upon this

with a steam pressure of 140 lbs. per sq. in. It is of the cross-compound type, with a piston valve to the high-pressure cylinder, double ported for steam, single-ported for exhaust; the low-pressure cylinder is fitted with a flat side valve. The speed is controlled by a Maclaren shaft governor, limiting the speed variation to 2 per cent. each way from the mean between no load and full load, and adjustable over a range of 10 per cent. while running.

Oil is forced to the working parts at a pressure of 30 lbs. per sq. in., the pump being driven from the cross-head by a rocking arm; the oil is filtered in a tank after passing through the bearings.

From the generator the power is led through switch gear supplied by Messrs. Dorman & Smith. The high pressure switch is triple-pole, each pole having two double breaks in series. Fusible cut-outs of the Mordey type are placed in the high pressure circuits. The switches are placed between slate panels in horizontal compartments. Double insulation is used throughout, and the handwheel by which the switch is operated is earthed and well insulated from the live metal. The main switchboard is equipped with Kelvin and White instruments, including two high pressure voltmeters and a high pressure ammeter, multicellular voltmeter and ampere gauge, double-pole double-break direct-current switch for coupling to the Exhibition power mains, automatic cut-out, &c. The synchronising switch, also supplied by Messrs. Dorman & Smith, is like the main switch in design; a 5-KW. transformer, supplied by the British Electric Transformer Company, is used for synchronising.

The motor-generator consists of a three-phase motor coupled to a direct-current dynamo. The former is rated at 130 B.H.P., at 600 revolutions per minute, and is supplied with current at 5,000 volts. The armature is stationary, and is generally similar to that of the generator. The magnet wheel is provided with 10 poles, with laminated faces and conical winding. The generator is one of the company's standard machines, giving 150 amperes at 530 volts; the field magnets are cast with the cores, which are provided with laminated pole faces. The field cores are former wound, the coils being slipped over the cores and held on by brass flanges, which in turn are secured by the screwed pole faces.

The armature is of the toothed core barrel-wound type; the core discs are of two sizes, so that the binding wire is slightly sunk. The commutator connections are of flexible conductors. The bearings are of cast-iron, lined with white metal, and are spherical seated. The brush gear of this machine is specially neat; the brush-holder carrier is supported from the magnet frame, to diminish vibration, and the brush carrier spindles are insulated with ebonite cast on. The brush-holders are made so as to be readily adjustable and very accessible.

The armature is well ventilated, and the commutator is carried on the sleeve which also carries the armature core.

The whole arrangement forms a bold and impressive exhibit, summing up in small space the main features of a complete plant for power transmission.

Besides the main exhibit, the company has various motors at work in the Machinery Hall, including one of 20 H.P. at Messrs. Burton Griffiths' tool stand, one of 5-H.P. driving direct a Broadbent hydro-extractor with vertical spindle, at 700 revolutions per minute, and a motor in one of the pavilions.

SMOKY FURNACES, AND HOW TO AVOID THEM.

By W. H. BOOTH.

(*Concluded from page* 258.)

In all cases named the best results as regards perfect combustion would always be obtained by firing on the coking system, as in fig. 1. Where mechanical stoking is employed the coking system will often prove best in the ordinary furnaces of Lancashire boilers, because, except for the cold furnace crown, the conditions are present for perfect combustion. Where the sprinkling system is employed there will almost invariably be a steady stream of smoke, aggregating a considerable volume during a day, and of serious moment if it were collected into a number of separate clouds, as in hand firing, but, as it is, passing the eye of the inspector, because, though continuous, it is not dense.

A continuously sprinkled fire never appears to attain a really high clear temperature, as in intermittent hand firing, and *this shows what is the average condition to be obtained in a furnace more or less water-cooled*, and how essential it is to abolish such conditions with bituminous fuel. In the event of perfect combustion 1 lb. of good coal will give out about 15,000 B.T.U. If its perfect combustion is secured with even so little as 14 lbs. of air, the resulting products will weigh 15 lbs., and the temperature will thus be $\frac{1,000}{K}$ Fahr., K being the relation of the specific heat to unity. With ordinary furnace gases the specific heat, as ordinarily accepted, is about 0·2, very nearly. Thus a temperature of about 5,000° appears possible. But in ordinary cases, with a total weight of 25 lbs. of gases produced per pound of coal, and a coal of only 12,500 B.T.U. capacity, the temperature cannot exceed 2,500°. This neglects the possible, or, rather, probable, if not certain, reduction of temperature due to the increase of specific heat of gases at high temperatures. Now with plain carbon fuels all the possible temperature attainable is attained upon the grate, but in the case of bituminous fuels the fire-grate temperature is at most three-fourths of that due to an equal weight of pure carbon, and even this temperature is reduced by the duty of volatilising the hydro-carbons. These hydro-carbons only add to the temperature as they burn off, and this must often be many feet from the firegrate. Here we see the difficulty of bituminous coals, an initially low temperature on the grate, and we find this low temperature further reduced by the boiler plates or tubes before the hydro-carbons are well ignited, and they never do or can become well ignited, for the parts of the boiler continue to absorb heat more quickly than any possibly continuing partial combustion can add a further supply. Herein lies the whole difficulty of bituminous combustion, a difficulty that has apparently baffled all inquirers, but has done so because they have persistently ignored the vital principle of sufficient temperature, and have failed to observe that the locus of heat generation of bituminous fuels is not a point, but a line of considerable length, and it is only by embodying this fact that success is to be attained. Exactly the same error was made by most designers of refuse destructors. Here the burning of a fuel, laden with moisture, and containing a large proportion of green vegetable matter, has been attempted upon the grates of boilers which themselves formed one boundary of the furnace. In such circumstances it is impossible for thorough or odourless destruction to take place, and successful destruction is only possible where the furnace is completely refractory, and where there is a sufficient further length of firebrick flue to be maintained at a clear red heat, so that any sudden outburst of polluted steam may be heated to a red temperature before any attempt is made to utilise the heat for boiler purposes. I am perfectly aware that it has been held by men of high standing that bituminous fuels are useless to the extent of the 20 or 25 per cent. of hydro-carbons they contain, and I am as fully persuaded that this false doctrine is merely a form of confession that its propounders have failed to grasp the facts of combustion, not only chemically, but physically and mechanically. Chemically, there appears to be nothing wanting but a certain proportion of oxygen, and, given this, where failure results, it is laid to the coal by those who have no remedy but double priced Welsh, irrespective of even Prof. Dixon's statements that the combustion of hydro-carbons demands the presence of water vapour in some proportion, or of the doctrine of mass action which teaches that combustion or other chemical action does not complete itself to the entire elimination of the constituents concerned.

Physically, there appears lacking nothing but a sufficiency of temperature, and it is in the physical aspect that boiler furnaces appear to me always to have been neglected. Mechanically, attention has been paid in the long furnaces of Lancashire boilers to the mixture of air and gases, and

soft-iron poles, wound with copper tape on edge, 1 in. wide

The engine, built by Messrs. Hick, Hargreaves & Co., is rated at 450 I.H.P., running up to 190 revolutions per minute,

even Belleville attempted to secure mixture by violent mechanical means, so as to burn the fuel gases before they got to the cold tubes. If the North-country coalowners would apply some of the rich harvest of about 20s. per ton in excess of the prices that have ruled for years before the late rise, to a repetition of the Wigan coal trials on different lines, they might supply a market that has been handed over to South Wales from sheer ignorance and apathy.

The Wigan coal trials demonstrated that in ordinary Lancashire furnaces the bituminous fuels of Lancashire and Cheshire could be burned smokelessly by good hand stokers, with a nice draught and well-arranged air admission. But I think they also help to prove that the critical margin between success and failure is too narrow, with water-cooled furnaces, to be relied upon in most cases in actual practice. What is now wanted is a series of tests upon furnaces designed in accordance with experience, and I maintain that no furnace is so designed which includes a serious area of water-cooled plates. It is pitiable to see the North-country coalowners weeping over a shilling export tax on a very small proportion of their coal, when a subscription of one-tenth of a penny per ton for one year on the 180 millions of tons raised by them and other bituminous coal owners would bring in £75,000, a sum far in excess of what is needed for experiments to show how bituminous fuel might command the same price as Welsh, which price is up to 10s. a ton in excess of bituminous. Like so many of our rich men, the coalowners have waxed so fat and gross that they have lost all that spirit of enterprise and initiativeness that put England in the first rank. They have not failed to bleed an extra 20s. per ton out of the public "because of the war," on all their production, and now they grudge the paltry 1s. tax on a small fraction to pay a fraction of the cost of a war that has meant millions to them in extra profit.

Some years ago, when the Manchester Steam Users' Association carried out the Wigan coal trials, they showed that the Lancashire boiler could be fired smokelessly and produce an evaporative effect equal to Welsh, if proper care were only taken by skilled stokers, and circumstances generally were favourable.

It is my endeavour to point out that circumstances very rarely are favourable in practice. The draught is poor, or the flues are bad, or the fireman is inefficient, or some fault is present that militates against success, and it is evidently useless to depend upon a system which has a critical point so close to failure. It is thus really necessary that bituminous fuels should be further tested under suitable conditions, and shown to be capable of true combustion, not simply under favourable conditions, but under ordinary conditions, and this can only be done when the temperature is high. Temperature is, in fact, the prime necessity. Other factors are easy to secure.

Thus we are repeatedly told that the Belleville boiler would have been a success if properly stoked. Though this is not true, the Belleville boiler being otherwise hopelessly incorrect in principle, it is quite clear that any boiler that demands special stoking is wrong and unsuitable in naval work.

Where proper combustion is aimed at, as in the Weir boiler, it is only necessary to keep the bars covered with fuel to secure good results. No special training is required. A partially uncovered grate is, of course, wasteful, and firemen should be taught to fire as evenly as possible, and especially to fill the thin places in the fire so as to avoid excess of unused cold air.

MUNICIPAL TRADING.

Our contemporary, *Engineering*, in its monthly issue of *Traction and Transmission* for July, opens a discussion upon the question of municipal trading, the importance of which cannot be overrated. The opening article, which carries no editorial responsibility, defines the principal factors of the problem, and claims our first attention.

All parties admit that certain undertakings should be in the hands of a municipality, and we agree that the construction and maintenance of roads and sewers, sewage farms, baths, wash-houses, hospitals for infectious diseases, &c., essentially belong to this class; so also with the supply of pure water, which is absolutely essential for the well-being of every member of the community; these are the most substantial reasons why it should be under the control of the local authorities, although in many cases under municipal management it has not proved to be perfectly successful; but on the principle fairly laid down by our contemporary, viz., that it should be a condition of all business undertaken by a municipality that it meets "*some requirements of the majority of the inhabitants*, and not of a small class only," certain limited trading may be justified.

So far we are in substantial agreement, but when trading in the supply of electricity is recommended, we join issue, believing that it is impossible to justify it upon any sound principles of business.

In the first place, it is not a "requirement of the majority of the inhabitants," and with all the obvious advantages it possesses, the number of customers, even in towns where it has been available for many years, is very small, the proportion of users to the rest of the householders seldom reaching 10 per cent.

Take, for an example, some of the large towns, where electricity is supplied upon the most favourable terms to the consumer, and where the business has been established for a sufficient time, to have proved to the inhabitants, in the language of the suppliers, that it is the cheapest, the healthiest, the safest, the steadiest, the cleanest, the most pleasant, the most beautiful, and the most convenient means of obtaining artificial illumination.

At Brighton, the supply by the Corporation commenced in September, 1891, just 10 years ago; the prices charged are exceptionally low, viz., 7d. per unit for the first hour, and 1d. afterwards, resulting in an average price obtained of 3·27d. The town is an enterprising, flourishing, and beautiful one, where an electricity business has the most favourable chance of rapid development, and yet there are only 3,060 customers out of 21,648 inhabited houses, or, say, 14·13 per cent.

Glasgow is another instance where very low prices are charged, and every inducement offered to the public to use electricity—the average price obtained being 3·51d. per unit. In that city, according to the last published accounts, there were 2,852 consumers out of a population of 571,569, occupying 115,917 houses—or about 2½ per cent.

The first Corporation to establish electricity works was Bradford, where the supply commenced about 12 years ago, and here the number of customers is 1,277 in a population of 279,809, and other towns selected at random show :—

	Number of customers.	Population.	Years supplied.
Bath	330 ...	49,817 ...	11
Belfast	680 ...	348,000 ...	6
Blackpool	950 ...	47,346 ...	8
Bolton	888 ...	168,205 ...	7
Bristol	1,507 ...	328,842 ...	8
Bury	254 ...	58,028 ...	5
Chester	510 ...	36,281 ...	5

There is no valid reason, therefore, so far as demand is concerned, why local authorities should speculate in the supply of electricity, and interfere with a very legitimate business of the private trader.

The consensus of opinion among even those who favour such municipal trading, is opposed to the business being carried on for profit, and we agree with our contemporary that even if a Corporation could supply cheaper than the trader, it is not in itself a sufficient justification for undertaking a business, and particularly one of the character of electricity supply.

But if there is to be no profit on the trading, and consequently no contribution towards reduction of the rates, a common argument of the municipal trader falls to the ground. "Why," they say, "should we allow a monopolist company to come in and make profits, which we should make for the relief of the ratepayers?" Upon this abstract principle all the risks are incurred, with the usual result that, instead of any relief to the rates, large sums are required to make up losses.

The writer of the article assumes, quite as a matter of

furnaces of Lancashire boilers, because, except for the cold

of Lancashire boilers to the mixture of air and gases, and

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course, that Corporations can borrow money on better terms than the companies or the private trader; but is this so? The company starts with a subscribed capital, no interest to be paid unless profits are made; but what is the position of the Corporation? They start in a business they do not understand and without a penny of capital, and yet expect to do as well, or better, than the expert trader provided with both the necessary knowledge and money. Corporations must pay the interest on their borrowed capital whether they make a profit or incur a loss; how, then, can it be argued that they can finance on better terms than the private trader, whether carrying on business as individuals or by association with others as a company.

The article adopts the fallacy of the sinking fund extinguishing all the capital at the end of 20 or 30 years, "with no heavier burden during the period to the consumers than a company requires in perpetuity for the remuneration of its shareholders."

The writer appears to overlook the fact that if the Corporation could realise such a profit as to be able to repay all the capital borrowed, together with provision for renewal of the plant at the end of its short life, the consumers will have paid an enormously excessive price to procure such a result; but if this were so, in what would the position of the private trader differ? Would he not have been able to pay such large dividends that they would amount to the return of the whole capital? Where, then, does the perpetuity for the remuneration of the shareholders come in?

As a matter of fact, the private trader starts with a decided advantage over the municipality in having the interest for the shareholders which the Corporation must pay away on their loans.

Again, does the writer assume that at the end of the 20 or 30 years no capital will be required for carrying on the business? The sinking fund is one of the disadvantages under which municipal trading is carried on; for the capital account for an electricity supply, instead of being reduced by premature repayments, must be constantly increased to meet the natural development of the business, and no legitimate profit on the supply is possible that has to provide for the repayment of capital, as well as maintenance, depreciation or antiquation, and renewal of plant.

"The primary object of municipal trading," says the writer, "being to afford the consumer a better article or a lower price, any surplus arising from corporate management must be devoted, in the first place, to this end." This condition would seem to dispose altogether of the heavy margin necessary to pay interest, repay capital, maintain and renew the plant within 20 or 30 years.

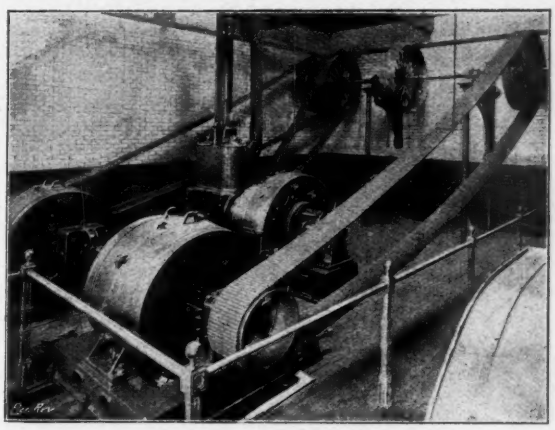
One of the conditions under which loans to corporations are authorised, is the formation of a reserve fund limited to one-tenth of the capital. This, of course, is intended for the purpose of providing for the renewal of the plant and the numerous contingencies and circumstances attending such a peculiar business. This fund would also have to come out of the profits before the ratepayers reached that happy condition when, at the end of 25 years or whatever period may have been assigned for the loan, they can look proudly upon their splendid asset, free from debt, and thank the generous consumers of electricity for contributing to the town such an *Ether*-ial El Dorado.

(*To be continued.*)

A BRITISH POLYPHASE INSTALLATION.

Amongst our most progressive manufacturing firms must be reckoned Messrs. Fletcher, Russell & Co., Limited, whose gas stoves and burners are common objects of the domestic economy throughout all countries, while their heavier workshop appliances are no less esteemed in the industrial field. Some time ago the firm removed the whole of their castings department for gas heaters and large hotel cooking stoves from Pendleton to Warrington, where they erected a factory on the most up-to-date lines, showing an enterprise and thoroughness which augur well for the maintenance of their high reputation. The works were completed about three years ago; their chief interest to electrical engineers rests in the fact that they are provided throughout with electric light and power—the latter being carried out on the three-phase system.

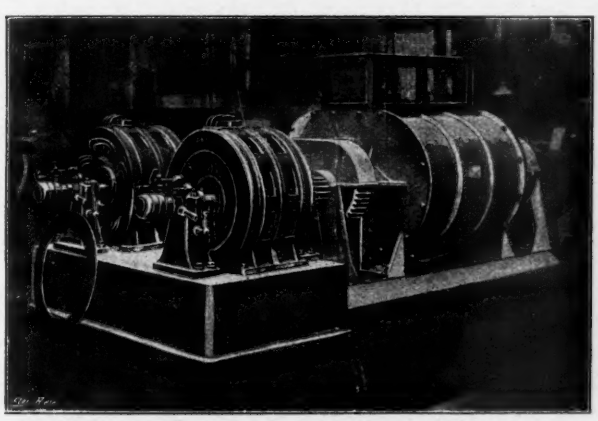
The office buildings afford accommodation for stores, general offices and board room, drawing office, and an enormous showroom, the latter being lighted with 18 three-light brass electroliers. The works proper are situated behind the offices, and are served by a siding from the L. and N.W. Railway.



Engine Room.

The boiler house contains two Lancashire boilers, each 30 ft. × 7 ft., and a Green economiser. The engine room is in the main building, and is equipped with a 135-h.p. tandem compound horizontal Corliss engine, by Sharples and Co., of Ramsbottom; these drive by rope a main countershaft. From the latter are driven by 12 in. leather link belts two 85-h.p. G.E.C. three-phase generators, and one G.E.C. direct current two-pole dynamo. There is also a G.E.C. multipolar dynamo, coupled to an Alley & McLellan "Sentinel" high speed engine.

The two-pole dynamo is of the D 20 type, compound wound for 110 volts, and capable of supplying 400 16-c.p. lamps when running at about 650 revolutions per minute.



Roots Blower driven by Induction Motors.

The "Sentinel" engine is of 80 h.p., and runs at 360 revolutions per minute, the fly-wheel being on the dynamo shaft and arranged for belt driving in case of need. The dynamo is of the four-pole type, having an output of 460 amperes at 110 volts. It is also compound wound, with bare copper strip; the brush-holder spindles are four in number, having five carbon brushes each. The two three-phase generators are used only for power purposes, and were made by the General Electric Co. (1900), Ltd., under the Oerlikon patents. They are of the inductor type, with six field poles, and the armature windings are mesh-connected, each limb being wound for 110 volts. The voltage per phase is, therefore, 190 volts, and the current per phase, with power factor unity,

problem, and claims our first attention.

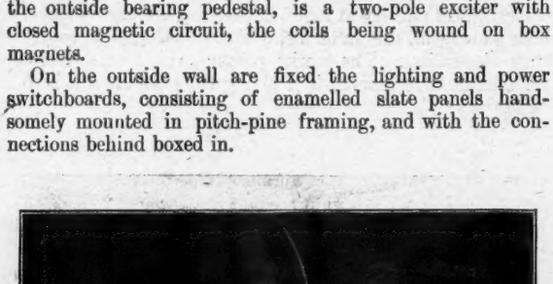
All parties admit that certain undertakings should be in

make up losses.

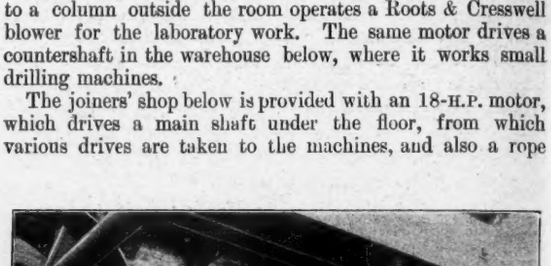
The writer of the article assumes, quite as a matter of

is 300 amperes. The frequency is 50 cycles, and the machines run at about 1,000 revolutions per minute. Mounted on each generator shaft, and supported on a bracket from the outside bearing pedestal, is a two-pole exciter with closed magnetic circuit, the coils being wound on box magnets.

On the outside wall are fixed the lighting and power switchboards, consisting of enamelled slate panels handsomely mounted in pitch-pine framing, and with the connections behind boxed in.



Shafting Driven by Motor on Column.



Shafting Driven by Motor on Wall Bracket.

The lighting board comprises two main S.P. dynamo switches, two ammeters, two voltmeters, two shunt rheostats, seven throw-over incandescent lamp circuit switches, seven S.P. fuses, and 12 S.P. arc lighting switches and fuses.

The board is so arranged that the incandescent lighting can be taken off either dynamo.

The power switchboard comprises three panels, the centre one containing the synchronising switches and lamps, and one three-pole bus bar switch and fuse. The two outside panels each contain one ammeter, one voltmeter, one three-pole switch and fuse, and one exciter rheostat. By this arrangement the motor load can be split into two, one half being worked separately by each generator, or both can be run in parallel, or either can work alone on the bus bars.

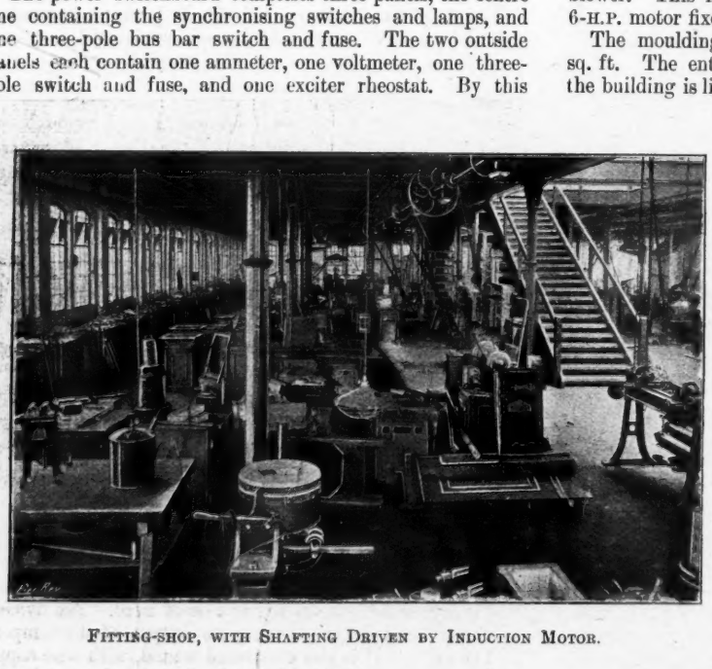
The room is well lighted from the roof, where a fan driven by a ¾-H.P. three-phase motor is fixed, and the walls are lined with white tiles.

The area of the works block is about 9,000 sq. ft., and the various floors are connected by a hoist made by Messrs. Archibald, Smith & Stevens, worm driven by a 7-H.P. three-phase motor, with safety gear, &c. On the first floor are situated the dental room, where dentists' amalgams are made, and the laboratory. A shaft driven by a 3½-H.P. motor fixed to a column outside the room operates a Roots & Cresswell blower for the laboratory work. The same motor drives a countershaft in the warehouse below, where it works small drilling machines.

The joiners' shop below is provided with an 18-H.P. motor, which drives a main shaft under the floor, from which various drives are taken to the machines, and also a rope upwards to a countershaft which drives light tools in this shop and the pattern shop above. Among the heavy tools driven by the motor is a 42-in. circular saw, a planing and thicknessing machine taking timber up to 19 in. × 9 in., a spindle moulder and cutter, band-saw, turning lathes, tool grinder, and other wood-working tools.

The smithy has six fires, supplied by a G 2 Roots blower. This is driven from a countershaft worked by a 6-H.P. motor fixed on a wall bracket.

The moulding shop is a space embracing over 30,000 sq. ft. The entire floor is laid with brick in cement, and the building is lighted throughout by numerous incandescent lamps in well glasses under enamelled iron reflectors.



Fitting-shop, with Shafting Driven by Induction Motor.

Adjacent to the moulding shop, and next to the railway siding, is the sand milling and mixing and drying room. The machinery comprises a 6 ft. pan, mortar and sand grinding mill, and a special high-pressure Roots blower for experimental purposes. These are driven by an 8-H.P. motor, fixed on a wall bracket, by means of a leather link belt to a countershaft.

The furnaces are erected on a substantial platform alongside the moulding shops. There are two cupolas, each 6 ft. diameter, and 40 ft. high, specially made to the designs and requirements of the company on the Stewart rapid-cupola principle. At the end of the platform is a hoist by Messrs. Archibald, Smith & Stevens for taking materials from the platform to the staging 20 ft. above. It is electrically-driven by a 7-H.P. three-phase motor with slip rings, through worm gear, and is capable of lifting 25 cwt. 20 ft. in 18 seconds. The furnaces work on alternate days, and deal with 120 to 130 tons of metal per week. The blast is conveyed to the cupolas through pipes of 20 in. diameter from a Thwaites No. 6 Roots blower. This blower is driven by a vertical steam engine at one end, or by two 20-H.P. three-phase motors at the other end, coupled one to each shaft, as shown on p. 379.

The machine-dressing shop is provided with a 6-H.P. motor fixed to a bracket on the wall; this drives by means of a countershaft two double emery-wheel machines, two single ditto, three rumblers, and tumbling barrels for dressing small castings. The dust from each machine is drawn into an underground passage by means of a Blackman ventilating fan, and is then discharged into the open.

In the grinding and polishing departments, where the doors and sides of stoves, &c., receive their bright edges, are seven grinding stones, and a number of polishing and buffing machines, belt driven from the Corliss engine in the adjoining engine house.

The large engineering, fitting and tinsmiths' department is a two-storey building, each floor having an area of about 15,000 sq. ft. The ground floor is used entirely for fitting, and is provided with numerous vertical drilling machines, large and small lathes, screwing machines, planishing hammers for copper work, planing and punching machines, power presses and guillotines; all these machines are driven from two lines of shafting running one on each side for the whole length of the shop. Each shaft is driven through 4-in. leather-link belting by a 10-H.P. motor fixed on a column bracket in the centre of the shop. The first floor contains a quantity of small drilling and sawing machines, driven by means of one of the 10-H.P. motors below, as well as emery grinding machines, lathes, and guillotines for lighter fitting work. The drilling and sawing machines have been specially manufactured and adapted for the firm's patent burners and appliances. About 24 of these machines are run from a line of countershafting which is driven by a 6-H.P. motor in the tinsmiths' shop.

The latter is a well-lighted place, in which are manufactured large numbers of copper water-heaters, dental furnaces, pure solid nickel muffles, copper cooking utensils, &c. Various tools are driven from the 6-H.P. motor, including polishing buffs, guillotines, and special tinsmiths' tools. Above the first floor are commodious store lofts. Situated in the centre of the building is a hoist, made by Messrs. Archibald Smith & Stevens, driven by a 6-H.P. motor through a countershaft, with fast and loose pulleys.

The works, which employ over 600 hands, are steam heated, and lighted electrically throughout; there are at present nearly 1,000 "Robertson" incandescent lamps in use, and eight "Angold" enclosed lamps are distributed about the yards. The whole of the electric light and polyphase power installation was carried out by the General Electric Company (1900), Limited, who were the pioneers to introduce this system into England. The whole of the generators and motors were built by the company at their Manchester works.

We have to thank Messrs. Fletcher, Russell & Co., Limited, for their courtesy, and the assistance they have given us to enable us to write this article.

THE DESIGN OF SWITCH GEAR.

By W. E. WARRILOW.

Now that the supply of electricity in large quantities is being more generally undertaken, too much importance cannot be attached to the switching apparatus. This portion of a station has not received the attention it demands until comparatively recent years, consequently the design of the controlling arrangements has suffered considerably.

The switch gear in a station ranks in importance ahead of any other apparatus, for two reasons:—(1) The whole of the power generated is concentrated in such a small place that accidents on the board are apt to cause failure of the entire supply. (2) The confined nature of the gear presents a certain element of danger to the staff (especially with high pressures). In the case of generators or boilers the breakdowns are more likely to be restricted to the units themselves, and where stand-by plant is available, such accidents can be allowed for in a short time; but with the switch gear matters are different. Fire, for instance, would probably necessitate the shutting down of the whole plant, and in case of destructive arcs, interruption of the supply would be hardly preventable.

Now, in the pioneer undertakings, the switch gear received little or no attention, the skill of engineers being devoted to the perfecting of the engines and generators. So much was this item of the station neglected, that the lives of the staff were endangered, and accidents through fire were of frequent occurrence.

Again, the attempts at switch gear construction were all on similar lines—an elaborate arrangement of instruments and switches on the front of wood panels in the early types, and slate in the later, while the connections were hidden from sight and carefully boxed in from other than authorised inspection. Such a design proved disastrous to a degree, and illustrated most clearly that nothing could justify its adoption. Probably the greatest incentive to improvement has been the loss of life incurred through deceptive connections, which have caused the most experienced men to be unaware of their danger. Again, there have been serious burns inflicted on many electricians who have accidentally "short circuited" terminals, which, by reason of their proximity to his work, have not been clear if a spanner or other tool should slip. These and other minor accidents have conclusively proved that the design referred to above is not worthy of a place in any modern station.

High Pressure Gears.

Of all classes of gear, those controlling high pressures are the most important, as there are many essential conditions to be fulfilled. Looking at some of the modern high pressure gears, it is a matter for wonder that the types adopted in pioneer undertakings ever fulfilled the demands made upon them. It was the common practice to mount all fuses, switches, &c., on the front of an ornamental wood framework, while the rear connections were arranged in a cupboard-like recess, affording little or no room for working, and presenting a veritable death-trap, in which a man might easily lose his life. Prolonged arcing at switch or fuse contacts would result in the destruction of either the panel affected, or the whole board, while heating at the back would damage the insulation of the connections, which were usually made with rubber-covered cables.

Experience of high pressure switch gears of this type has clearly indicated that no board controlling high voltages should have *any rear connections whatever*, and no amount of argument should persuade engineers to adopt the old design of gear, now that improvements have been brought about which dispense with all rear couplings. It is a noticeable feature of some of the modern examples of boards with back connections that the old rubber-covered cables have been replaced by bus bars and links insulated with a layer or two of rubber or other tape. Such an arrangement is an improvement on cable connections, but it does not eliminate the chief source of danger in a switch gear, namely, the connections at the back. Moreover, the working face of these gears presents every opportunity of accident, in that a man may stumble against live contacts having great differences of potential, and either be severely burnt or pay the penalty with his life.

Now, after many years of disaster, electrical engineers have been taught that there are certain features in high pressure switch designs which cannot well be dispensed with. These may be summed up as follows:—The frame of the gear must be incombustible as well as mechanically strong; metal charged at high potential must be carefully insulated from the frame, and secured beyond reach of accidental contact by the attendants; *there must be no connections at the rear of the board.*

At least one gear on the market can fulfil these conditions, so that it will be observed that they are by no means impossible of accomplishment.

As far as the design of the controlling apparatus itself is concerned, great diversity of opinion exists, though the tests of experience are but little affected thereby. A high pressure circuit of large power is undoubtedly broken most suitably in an oil chamber, be the apparatus switch or fuse, and no satisfactory design of either, occupying a small space, breaking in air, has yet been produced. The oil switch possesses certain objectionable features, but it nevertheless takes up little room, and will safely open the circuit for

which it has been designed; moreover, it is accessible for cleaning and repair. A switch breaking large power circuits in air will be fixed high on the wall, and operated by levers placed on the engine room floor, and should it fail to open the circuit, considerable damage would be done before the arc could be put out, or burned itself out. Air break fuses are similarly destructive in the performance of their duty, damaging themselves and their neighbours on many occasions, beside presenting grave dangers to the attendants.

Synchronisers and voltmeters should always surmount the board, so as to be in the best position for reading, and to be clear of accidental contact. Synchronisers can be constructed to occupy little space, the feet forming terminals, while a voltmeter and lamps surmount the whole. This does away with straggling connections and small switches. Voltmeters can be dealt with in a like manner. A transformer need not be used, as an electrostatic instrument may be placed directly in the high pressure circuit, again dispensing with unnecessary complications. The legs of the voltmeter may be used for terminals in a similar manner to the synchroniser, this arrangement making it very easy to replace either instrument with a spare in case of accident.

The field connections of high pressure boards are worthy of notice here, forming as they do a vital part of that apparatus. Without doubt the exciter rheostat ammeter and switch should occupy a position directly under the machine panel which they control, as when placed here the attendant is less liable to make mistakes, and regulation can be effected more easily when changing machines. The rheostat should be self-contained, occupying a space under the switch platform corresponding to the machine panel on the main gear to which it belongs. Multiple contact switches, with cable connections running to resistance frames, can never give entire satisfaction, at any rate, as compared with a rheostat which can be held down with four bolts, and connected to the circuit in a short time. Again, should accident befall the compact type, it can be replaced at short notice by a fellow. Not so with the resistance, having a large number of sweating sockets and connecting cables, which take a considerable time to couple up. Even series resistances, carrying large currents, can be constructed to occupy but a small space, thus placing them far ahead of any multiple contact switch and separate resistance frame.

The bus bars having a high potential should be well out of reach at the top of the board, and there is no need to cover them with insulating material, as such precautions are unnecessary. Links or plugs may be handled with safety by using insulated tools, which protect the attendant from shock, especially if he be standing on a pair of steps.

Considered as a whole, there is no reasonable excuse why the old type of switch gear should be any longer erected, representing, as it does, the worst features of switchboard design, and containing few, if any, redeeming points. With a gear of the cell type, the chief difficulties are removed, and the few defects are quite counterbalanced by many advantages.

Now that both two and three-phase working are being more readily adopted, it behoves engineers, for the credit of the industry, to make use only of those designs of gear which have come to the front by reason of their undoubted advantage over other types. The practical success of the large power undertakings, so soon to be started in this country, depends as much on the design of the switch gear as it does on the efficiency of the generators, or more, if anything.

Again, schemes of such magnitude are expected to remain almost for all time, so that the innovators are really responsible to those who will follow them, as far as the success of the station is concerned.

In electrical matters experience has proved a hard teacher, but there can be no gainsaying her doctrines, no matter how much shuffling may be done. This applies more to high-pressure switch gears, perhaps, than anything else, and considering the lessons taught, it can be said with truth that there is little excuse for mistakes in modern design.

(To be concluded.)

Crieff.—The T.C. is considering the question of leasing its provisional order to a company.

CORRESPONDENCE.

Furnace Temperatures.

I have read Mr. Booth's article on the above subject in the Electrical Review with great interest. There are, however, one or two points which I would like to mention. In the first place I would like to ask, if it be allowable, in order to give an explanation of the processes of combustion going on in a furnace, to either give as a process actually occurring one which is utterly impossible, or to use inaccurate language with the idea of rendering the comprehension of the action easier. I refer to what Mr. Booth designates as the "evaporation of carbon." An evaporation of carbon, in the ordinary sense of the word, does not occur in a fuel furnace at all. In the extremely high temperature of an electric furnace it does perhaps occur, but even this is doubtful. Mr. Booth says: "To evaporate carbon requires 5,817 British thermal units per pound, this being the difference between the calorific capacity of carbon burned to its monoxide and of this monoxide burned to dioxide respectively."

Translating this into thermo-chemical equations, and using the figures given, one gets

$$\underset{\text{solid amorphous}}{C} + \underset{\text{gas}}{O_2} = \underset{\text{gas}}{CO_2} + 14{,}647,$$

$$\underset{\text{solid amorphous}}{C} + \underset{\text{gas}}{\tfrac{1}{2}\,O_2} = \underset{\text{gas}}{CO} + 4{,}415,$$

which gives

$$\underset{\text{gas}}{CO} + \underset{\text{gas}}{\tfrac{1}{2}\,O_2} = CO_2 + 10{,}232,$$

and we have

$$\underset{\text{solid amorphous}}{C} + \tfrac{1}{2}\,O_2 = CO + 4{,}415.$$

According to Mr. Booth, the difference between these last two equations should give the latent heat of vaporisation of carbon, *i.e.*, the equation,

$$\underset{\text{vapour}}{C} - \underset{\text{solid amorphous}}{C} = 10{,}232 - 4{,}415 = 5{,}817.$$

This can only be the case when one assumes that

$$\left.\begin{matrix}\text{the heat of}\\ \text{combination of}\\ \underset{\text{gas}}{CO} + \underset{\text{gas}}{\tfrac{1}{2}\,O_2}\end{matrix}\right\} = \left.\begin{matrix}\text{the heat of}\\ \text{combination of}\\ \underset{\text{vapour}}{C} + \underset{\text{gas}}{\tfrac{1}{2}\,O_2}\end{matrix}\right\} = 10{,}232,$$

that is to say, that the methods of combination of the two oxygen atoms in the CO_2 molecule are identically alike, and that they enter into combination with the vaporised carbon atom with exactly the same liberation of energy. This is, however, quite an arbitrary assumption, and one for which we have no experimental proof. The oxidisation of carbon to CO_2 cannot, in fact, be regarded as occurring in two equal and alike steps. The first combination is that between solid carbon and oxygen to form monoxide, which in its turn is oxidised as far as the condition of equilibrium of the gaseous mixture will allow to CO_2. At any rate, to speak of the "vaporisation of carbon" in a boiler furnace is misleading. What Mr. Booth no doubt really means is the latent heat of vaporisation of the volatile hydrocarbons already existing in the coal. The proper way, therefore, to get at the amount of heat lost at the grate by the vaporisation of these compounds would be to analyse (or fractionate) the coal and from the analysis and the known latent heats of the constituents calculate the value required.

In his calculation, too, of the maximum temperature obtained by the combustion of carbon in the exact sufficiency of air, Mr. Booth apparently has overlooked the fact, not generally recognised, that the temperature obtainable in a furnace burning carbon is limited by the dissociation of the carbon dioxide which occurs. Neglecting this, the maximum temperature comes out, as Mr. Booth says, to 4,892° F. The correct value, however, can be calculated as follows:—

The partial pressure of the carbon dioxide in the furnace may be taken to lie somewhere between one-tenth of an atmosphere and one atmosphere. From the data obtained from the researches of Deville (see Nernst "Theoretische Chemie," 2nd edition, page 416), the following empirical formula, showing the variation of the degree of dissociation with the temperature between the limits 2,000° C. and

necessitate the shutting down of the whole plant, and in takes up little room, and will safely open the circuit for

3,000° C., between which the maximum temperature lies, can be deduced.

$$\% \text{ dissociated} = a = 7 + 0{\cdot}05\ (t - 2{,}000),$$

where $t°$ C. is the maximum temperature.

That is to say, at this temperature $(100 - a)$ % of the carbon will be fully combusted to CO_2, and a% only to CO.

We, therefore, get the heat of combustion under these circumstances to

$$[100 - \{7 + 0{\cdot}05\ (t - 2{,}000)\}]\ \frac{97{,}000}{100}$$

$$+ \{7 + 0{\cdot}05\ (t - 2{,}000)\}\ \frac{28{,}000}{100}$$

$$= 161{,}000 - 34{\cdot}5\ t \text{ gramme-calories.}$$

Now, the heat capacity of the products of combustion and the nitrogen remains the same, as although some of the carbon is only burned to CO, yet 11·6 times its weight of air must still be passed into the furnace to preserve the chemical equilibrium of the gaseous mixture. If less air be passed in more CO_2 will be split up and thus energy absorbed. The equilibrium balances itself according to the well-known law of mass action, and if the concentration of one of the constituents be lowered chemical action will occur tending to form the constituent which has been removed.

This heat capacity in gramme-calories is 35·7, therefore,

$$\frac{161{,}000 - 34{\cdot}5\ t}{35{\cdot}7} = t$$

which gives $t = 2{,}300°$ C. $= 4{,}172°$ F., which is considerably lower than the value given by Mr. Booth. This affects the calculations right through, and it is true, if Mr. Booth's theory be right, rather accentuates his point of the low temperature of the furnace. The heat required to volatilise the volatile parts of the coal is, however, most probably much smaller than that given by Mr. Booth. The most rational method to get over the difficulties pointed out would be to utilise the waste heat to warm the air before passing it through the grate. This method, of course, is used in many smelting and other furnaces, and the efficiency of such furnaces is very considerably increased thereby.

Charles C. Garrard.

How to Kill Technical Education.

The recent correspondence *re* a student's complaint in your columns, throws a very lurid light on much that has hitherto been rather obscure. It is a recognised fact that the immense strides made by Germany during the past two decades, are the result of her excellent educational facilities, *i.e.*, to the study of theory, and it is equally plain that the stagnation so obvious at present in this country is due to the lack of these facilities. In the way of buildings, &c., much has been done to remedy these defects, but since the large majority of employers have themselves never enjoyed a modern technical training (*i.e.*, theoretical) they throw every obstacle in the path of one who aspires to something higher. The injustice of their treatment of the individual, sinks, however, into insignificance in contrast with the injury they do to the cause of progress in general. A young man of 18 who wishes to become an engineer, has the choice of two methods of reaching the desired end. He may pay a premium and enter some works where nobody takes the trouble to teach him anything, and he is left to pick up as much or as little as he chooses, or he may enter a technical college, where specially trained men are engaged and well paid to initiate him into the mysteries of his craft. In the first case, at the end of four years he is regarded as a practical man of experience, and finds no difficulty in securing remunerative employment. In the second case, in this country at least, he is regarded by the practical man as of less value than an apprentice boy, and unless he is an exception and can afford to work for some considerable time for nothing, he lives to curse the day he ever saw the inside of a college.

Again, it is claimed that electrical forms only a part of mechanical engineering. Is this so? Is not mechanical engineering based upon mathematics, physics and chemistry, and does not a knowledge of electricity also comprise some knowledge of these subjects, with the addition of magnetic phenomena? Does not engineering practice owe all advance during recent years to chemistry and electricity? Are the locomotives of to-day, for example, any better than those built 40 years ago? After many years mechanical engineers are enabled to produce an engine that will convert 20 per cent. of the energy supplied to it into useful energy. The limits of mechanical engineering proper having been reached years ago, mechanical engineers have been content to follow practice and ignore theory, and this habit has led men in this country to treat electrical problems in the same way, leaving to the American and the German the honour of theorising and experimenting. In mechanics such methods may be justifiable, but their adoption in electrical engineering is leading to disastrous results.

In engineering, as in everything else, the great advance made during the last few decades is due to specialising. Now, whether we regard electricity as a part of mechanics or not, it is very certain that great efficiency can only be attained by means of specialising. The mechanical engineer with a smattering of electrical knowledge may be likened to the general medical practitioner, and the electrician to the specialist, whose sole aim it is to keep abreast of the times in his speciality, leaving to the general practitioner the handling of those subjects which practice and experience have placed upon a firm basis. It is owing to the Englishman's inability to grasp this all-important fact that the ill-success of many electrical generating stations in this country may be attributed. Long ago the general practioner saw the futility of attempting to compete with the specialist, and when the mechanical engineer in this country realises the fact that he is on a par with the general practitioner, then technical specialisation will receive due recognition, but not before. The medical student of four years' standing is entrusted with a responsibility involving life and death. The technical student of like standing is, in the eyes of the practical man, as incompetent as an infant. Does this incongruity spring from a faulty training, or does it exist only by reason of the peculiar views of English employers of labour?

Specialiser.

Central Station Man's Grievance.

When a man goes so far as to say that electrical engineering is only a *branch* of mechanical engineering, he either says this from ignorance of what electrical engineering really is, or else is carried away by his own importance, or of that of the profession to which he presumably belongs.

I should be sorry, indeed, to think that because a mechanical engineer does not know all about electrical work he does not know his business, but that is what C. J. Greene implies in his letter to you in your issue of the 30th inst. I began as a mechanical engineer, and put in six years in the shops, and when I first thought of taking up electrical work I was told by a mechanical engineer, who had been some years in charge of the mechanical portion of the work in a lighting station of some importance, that I should pick it all up in 18 months. Well, I have since then passed through a course in electrical engineering at a prominent technical college, and have since been working in electrical work for four years. I am quite satisfied with my progress, but must admit that instead of having "picked it all up," have still a long way to go; I am still a student, and I hope the day is far distant when I shall cease to study either from books or from any other source from which I can gain more knowledge of the profession to which I am proud to belong.

The great mistake that most mechanical men make when taking up electrical work is that they believe there is little or nothing to learn. The few that do recognise that they have something to go through before they get an understanding of electrical matters make good progress; they then become mechanical and electrical engineers, the latter, to my mind, being quite distinct from the former; where you get a combination of both, it follows that you have a good man. The quicker mechanical engineers taking up electrical work recognise the fact that, after having learned everything mechanical, there still remains something to be learned electrical, the better it will be for themselves and for those employing them to fill posts in central stations.

I am afraid I have wandered somewhat from a "Central

Station Man's Grievance," but when one sees remarks such as the one to which I have referred, one is prompted to say something.

F. P.

Doncaster, *August 30th*, 1901.

With reference to the correspondence in your current issue as to the best men for shift engineers in central stations, I think the arguments on both sides—*i.e.*, electrical students *v.* marine engineers—go to substantiate my opinion that an "electrical engineer" (which term I take to mean a man who has had both theoretical training and practical experience in electrical workshops) with, say, two or three years' marine experience in any of our large passenger liners, may claim to possess all the necessary qualifications for a shift engineer.

W. R.
(Late Electrician, Mercantile Marine.)

August 31st, 1901.

In regard to the letters published in your paper *re* marine engineers as central station men, I consider students are as a rule a great deal to blame in this matter. The main reason marine men are being taken into central stations is, in reality, because they are considered as permanent fixtures. As they have probably been to sea a number of years, "possibly in the same boat all the time," when they do get a shore job in a central station and have the comforts of a home life, especially if married, they are in no hurry to throw over such a job, and even if there are places vacant in other stations at a larger salary, they do not bother to apply for them, but are quite content to remain where they are. Now, a student starting central station work, after he has been a short period in one place, and is just learning to be of some practical use in the station, sees the chance of bettering himself, and leaves for some such place. Now this is very aggravating to a chief, as he will have to look out for another man to take his place, who will have to commence at the beginning, and will be possibly some time before he gets into the grooves of this particular station. So you see it is better to secure a man who will be content to remain with you, than one who will move at the first opportunity, be he ever so good.

W. G. R.

I should like a few words in your valuable paper respecting purely mechanical men as charge engineers. During my time I have met men trained in every possible way, and my opinion is that all depends on the man.

I fancy it is one of the few fads our consulting engineers and chiefs have in the appointment of purely mechanical men, or otherwise they are so purely electrical themselves that the mechanical work looms up like a nightmare, as minor electrical matter does with a purely mechanical man, if he is too old to grasp the theory properly. It is quite time the chief engineers who have no faith in electrical men resigned their appointments, advising their committees to fill their positions with marine engineers or fitters.

As regards the training, I should certainly recommend a pupilage before an apprenticeship, as a pupil has far superior advantage, either in the shops or central stations. He will be allowed to go through the shops, drawing offices, &c., while the apprentice may be kept on one specialty. The workman will also be more civil and willing to teach him.

I should also like to ask what sort of men we shall admit to the profession if they can enter without being put to any expense? I presume a youth (or his parents) not only thinks of his liking and qualifications for the work he enters upon, but the social position and men he will have to mix with.

I think a man could become a good central station engineer in the following way:—Leave school fairly early and go to an electrical and mechanical college for about two years, and on leaving there become a pupil for three or four years at a fair size station keeping five or six fitters and workshops. During this time he would be in touch with all breakdowns likely to occur in every department.

Fiat Justitia.

With regard to Mr. Greene's last letter I would point out one statement he makes, viz., that electrical engineering is a branch of mechanical engineering. Now, neither mechanical nor electrical engineering are distinct professions, as both are a branch of engineering, but, of the two, electrical engineering is more nearly a distinct profession than mechanical, because it embraces mechanical engineering whilst being based on a separate science.

"A Lover of Fair Play" has so ably exposed Mr. Snell's "philanthropic methods," that any remarks I might make on this matter would be merely wasting valuable space.

The only necessity remaining is for me to explain that my signature, "An Enlightened Student," does not refer in the slightest to any enlightenment I may have on matters mechanical or electrical, but means that I have been enlightened as to the unscrupulous methods of the "marine fitters" in obtaining situations that are the legitimate due of the "electrical student." If, as many of your correspondents suggest, the "marine fitter" is the better man, might I ask what is his object in accepting salaries at which an "electrical student" would scoff? The true case is, that he is tired of the sea, and rather than remain on his boat, he jumps at the first thing that comes along, and absolutely, without scruple, will obtain a charge engineer's job at 35s. a week, and leave other, and in many cases more suitable men, without a chance of obtaining satisfactory employment in the profession for which they have been educated, and which they have more or less right to call their own.

The suggestion contained in the letter of Mr. "F. W. P." would, if acted upon by one of the Institutions, prove of enormous benefit to the at present despised "younger members."

I beg to apologise for encroaching so far upon your valuable space, and thank you for your kindness in allowing me the use of your journal for this discussion.

An Enlightened Student.

September 3rd, 1901.

[This correspondence is now closed.—Eds. Elec. Rev.]

Electromobile Tour.

Allow me to correct the erroneous statement in your issue of the 30th ult., under the heading "Woking," according to which the honour of organising the splendid tour of the electric vehicle, the "Powerful," is attributed to me. This is not the case. Mr. Theodore Chambers, managing director of the British and Foreign Vehicle Company, is solely entitled to the credit of having conceived and carried out the idea of demonstrating the practicability of electromobiles by touring in his car, the "Powerful," on a scale that has never before been attempted, and his complete success is an eloquent testimony to the soundness of his views and the energy he has brought to bear on the matter; not the least part of Mr. Chambers's labours in the cause of British electromobilism is a map which shows at a glance the various charging stations in this country; these are already quite numerous, and it may be reasonably expected that charging facilities will very much increase in the future.

From information that has reached me—and which may interest your readers—the "Powerful" has beaten its own record of 96·75 miles on one charge during its trip from London to Glasgow.

My own connection with Mr. Chambers's successful tour is indirect, and is entirely confined to the circumstance that the battery which has been used throughout is a Leitner battery.

The works at Woking to which you refer are those of my company, the "Accumulator Industries, Limited," not "Automotor Industries," and they are about to be

quadrupled as to size and output. The manager of the works is Mr. B. Kuettner, the actual builder of the battery now in the "Powerful."

Henry Leitner,

Managing Director, Accumulator Industries, Ltd.

Woking, *Sept. 2nd*, 1901.

Water Supply for Power Stations.

I can confirm the opinion you express in your current issue as to the advisability of consulting engineers giving further attention to the above matter, especially since the recent introduction of a new system which facilitates and expedites the cooling of the condensing water for the engines, and renders entirely unnecessary the enormous costly and valuable space-absorbing cooling towers and reservoirs.

The system I referred to may not yet be known to you and many of your readers, as it has only just been brought out in Lancashire. The principle is to carry up the hot water into a trough placed on the ridge the full length of the roof, out of which it overflows on each side and gravitates, dribbles or trickles down the roof in a thin film into the rain trough, and down the down spout and back to the well or a small cistern, and is circulated continuously.

Being exposed to the atmosphere, which at the altitude of roofs is invariably in motion, as a breeze or wind, it is, of course, more rapidly cooled to a lower temperature which, of course, means a higher vacuum with less water, increased efficiency, and greater economy. The system only costs about one half of tower installations. The cooling is also expedited by the rain-fall, which compensates for evaporation; the surplus being collected by gravitation or otherwise, into a reserve which may be formed round the chimney by boiler-plates forming a cavity about 2 ft. wide or 4 ft. larger in diameter than the chimney at the bottom, to hold from 50 to 100 thousand gallons. As the rain-fall during the night is also collected, no other water supply is needed, although in cases of emergency there is, of course, the water-main to resort to, if at all necessary.

I enclose an illustrated description of the system.

Jas. T. Pearson.

Burnley, *September 2nd*, 1901.

THE INTERNATIONAL ENGINEERING CONGRESS OF 1901.

Abstract of Introductory Address to the Electrical Section (Section IX.) by the Chairman of the Section, Mr. W. Langdon, President of the Institution of Electrical Engineers.

I propose to approach you, very shortly, upon a subject which I feel to be one of the highest importance.

Just fifty years since, London gave birth to the first International Exhibition, which was followed by numerous others at home and abroad.

There can be no question that the result of these great undertakings has been for good; that they have been a stimulus to manufacture and trade; and that—greatly beyond all else—they have been a means making for peace.

Manufacture has become cosmopolitan, and the rivalry of the future between the most advanced nations of the earth will be that of manufacture.

Lord Rosebery recently remarked: "We are coming to a time of stress and competition, for which it is necessary that we should be prepared," and "It is necessary for a nation in these days to train itself by every valuable method to meet the stress and the competition that is before us."

The question whether England, in comparison with other nations, is becoming retrograde in her industrial achievements, must prove one of peculiar interest to all who seek this country's welfare. There are grave reasons to fear that in some paths, especially in that development with which this Institution is so closely allied, we have not retained that prominent position which has characterised this country for so long a period.

Twenty years back British manufacture stood on level ground with other countries in the production of electrical machinery, yet we have, from some cause, failed to meet even our home demands. It appears that of some 300,000 I.H.P. of steam engines laid down for lighting and traction, 73,000 have been imported from the United States of America; and that of some 200,000 KW. capacity of generators, 71,000 were derived from the same source.

England did not meet the demand! Can it be that the British manufacturer lacked confidence in the permanency of this new electrical development? The capital invested in European countries and the United States in electric lighting, power, and traction works, amounts to £367,000,000. Of this sum the United States contributes £200,000,000, and Great Britain £35,000,000. The number of miles of single track equipped for electric traction in the two countries is, relatively, 21,000 and 900. Of motor cars, 68,000 and 2,600. Germany, where the power employed for lighting work approaches closely that of England, has 2,300 miles of track, and 5,400 cars, although the invested capital is but £29,000,000, as against England's £35,000,000 for an enormously less mileage and smaller equipment.

These figures should prove effectual in disposing of any doubt that electrical development is stable. It is not with its utility that I desire to deal so much as with the means for its production; the production by our own country of all that is needed to meet not merely the wants of our own demand but that of our colonies as well.

Two important factors—cost and promptitude of delivery—attend successful competition in manufacture. Inspired with confidence in the future of electrical work, and unencumbered with many of those restrictions and regulations which attend similar undertakings in England, other nations have seized their opportunity, gained experience, standardised their productions, and have thus, in advance of this country, prepared to meet any ordinary demand that may arise.

Cost depends much upon our labour conditions. Within a very short period rivalry in manufacture will be far more acute than is even now the case, and in it labour will play the chief part.

Unhappily, identity of interest, so necessary to both master and man, is more frequently marked by its absence than its presence. Until the employé can be induced to recognise in a practical manner the fact that his employer's interest is also his interest, those labour regulations which have been fruitful of so much harm to the manufacturing interests of this country, and which must in the end prove disastrous to the workman, will continue.

We are speedily approaching a condition in the industrial progress of the world that will test to the utmost our position as a nation; for the pre-eminence of a nation will in future be largely determined by its progress in manufacture.

It behoves us to consider how our manufacturing industry is placed in relation to that of other countries with which we have to compete. The question is one of unexampled importance. We have seen that England, once the chief source of iron and steel rails, has in that industry met with serious rivalry. Why is this so?

We see other countries prepared, and preparing to take advantage of every new development in industrial progress. We see vast sums of money embarked in it, and especially in the use and advancement of electricity in its various modes of application, and we see that here in England—the pioneer of mechanical power and progress—we are indebted to a foreign source to meet a great portion of our wants. There is a cause, and if our country is to retain her rank as a nation it is necessary that this cause, whatever it may be, should be ascertained, and, if possible, removed ere it is too late. The subject is one which may, I humbly and earnestly submit, claim the most careful consideration of every branch of our legislative administration, our labour organisations, and of every citizen of the British Empire.

KELVIN'S ELECTRIC MEASURING INSTRUMENTS.

By Prof. Magnus Maclean, D.Sc., M.I.E.E.

(*Abstract of Paper read in Section IX.*)

The date of the beginning of exact electric measurements in electrical engineering may be roughly put about 20 years ago, and since that date Lord Kelvin has taken out 27 patents relating to improvements in instruments for generating, regulating, measuring, recording, and integrating electric currents. Eleven other patents relate to improvements in electric telegraphic apparatus.

Electric measuring instruments may be conveniently classified under four heads:—

A. Electrometers.

B. Electro-magnetic instruments for measuring currents and differences of potential.

C. Electro-dynamic instruments for measuring currents and differences of potential, and electric activity.

D. Instruments arranged for recording and integrating electric currents.

A.—Electrometers.

Electrometers are divided into (1) symmetrical electrometers, and (2) attracted disc electrometers. By means of these electrometers differences of potential from $\frac{1}{100}$ volt to 100,000 volts can be accurately measured. The symmetrical type of electrometers includes (*a*) quadrant electrometers, (*b*) multicellular electrometers, and (*c*) vertical electrostatic voltmeters. The principle on which these instruments act is that of an air condenser, in which one metal part is movable about an axis, so as to increase or diminish the capacity. These instruments are so well known, that no detailed description need be given of them. They have the great advantage of being available as accurate measurers of potential on direct and alternating systems. As they use no current, they require no temperature correction, and they are, therefore, free from the causes of error so prevalent in instruments of the electro-magnetic type.

A. (2) The attracted disc electrometers include:—(*a*) Absolute electrometers; (*b*) Long range electrometers; (*c*) Portable electrometers; (*d*) Electrostatic balances.

Electrometers (*a*), (*b*), and (*c*) are described in detail in Kelvin's "Electrostatics and Magnetism." The fixed portion of the condenser in the electrostatic balance is a brass disc supported on three glass pillars, and the movable part is a round aluminium plate supported by two long links on two knife-edge stirrups on one end of a counter-poise indicator. The whole movable portion is supported by knife-edges on two brass pillars. The balancing force is the gravity of some definite weights supplied with the instrument, the weights being so graduated that differences of potential from 500 volts to 100,000 volts can be measured.

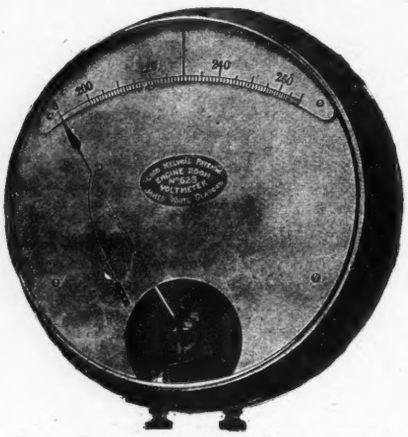


Fig. 1.—Round Pattern Suspended Coil Amperemeter and Voltmeter.

In connection with these electrometers, mention should be made of the Standard air Leyden condenser, as, in conjunction with a suitable electrometer, it affords a convenient means of quickly measuring small electrostatic capacities, such as those of short lengths of cables.

The instrument is formed by two mutually insulated metallic pieces, A and B, constituting the two systems of an air condenser, or, as it may be called, an air Leyden. The systems are composed of parallel plates, each set bound together by four long metal bolts. The four bolts binding together the plates of each system pass through well-fitted holes in the corners of the squares, and the distance from plate to plate of the same set is regulated by annular distance pieces which are carefully made to fit the bolt, and are made exactly the same in all respects.

The two systems are made up together, so that every plate of B is between two plates of A, and every plate of A, except the two end ones, which only present one face to those of the opposite set, is

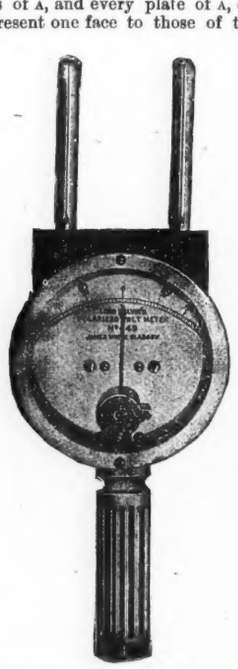


Fig. 3.—Portable Paralleling Voltmeter.

between two plates of B. When the instrument is set up for use, the system B rests, by means of Lord Kelvin's well-known "hole, slot, and plane" arrangement engraved on the under side of its bottom plate, on three glass columns which are attached to three metal screws working through the sole-plate of system A. These screws can be raised or lowered at pleasure, and, by means of a gauge, the plates of system B can be adjusted exactly midway between, and parallel to, the plates of system A.

In order that the instrument may not be injured in carriage, an arrangement is provided by which system B can be lifted off the three glass columns and firmly clamped to the top and bottom plates of system A.

Fig. 2.—Suspended Coil Reflecting Galvanometer

A dust-tight cylindrical metal case, which can be easily taken off for inspection, covers the two systems, and fits on to a flange on system A. The whole instrument rests on three vulcanite legs attached to the base-plate on system A, and two terminals are provided.

B.—Electro-magnetic Instruments.

B. 1. Among the earliest of the electro-magnetic instruments (leaving out of account the reflecting, differential, and ballistic galvanometers of more than 40 years ago), and certainly among the most convenient for giving a very wide range of current measurement, were the graded galvanometers. By means of these instruments currents from 4 milliamperes to 200 amperes and differences of potential from a small fraction of a volt to 200 volts can be readily measured. Both these galvanometers are of the movable needle type.

B. 2. Of recent years Lord Kelvin has reverted to his siphon recorder type of instrument, in which there is a movable coil in a fixed magnetic field. The first instrument of all the suspended coil pattern was Weber's electro-dynamometer, in which a fixed coil acted on a movable coil capable of rotational displacement

Fig. 4.—Rail Tester in Use.

round an axis. The first suspended coil instrument with field due to a steel magnet was the invention of Rev. H. Highton. The coil was supported on pivots between the poles of a steel magnet. It was used by the British and Irish Telegraph Company as a receiving instrument about 1856 and 1858. Lord Kelvin greatly improved this form of instrument by introducing a fixed soft iron core in the

siphon recorder of 1867. This soft iron core has made the present form of instruments practically valuable. The permanent magnets are circular compound horse-shoe magnets specially treated to ensure permanency. With good quality of steel, a proper preliminary ageing of the magnets (by heating them several times in boiling water and cooling them again, and subjecting them to somewhat varied usage) brings them to a condition in which the magnetism is found to remain exceedingly nearly constant. The coil or movable system is supported on ligaments, or flat spiral springs, which also act as the conductors of the current, and thus friction due to pivots

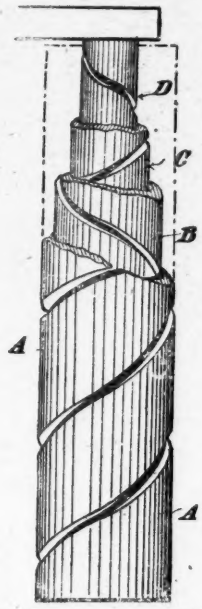


Fig. 5.—Coil of Ampere Gauge.

is entirely avoided. In the voltmeter type any degree of sensibility can be attained with perfectly dead beat action, and ranges up to 1,000 volts. There are six patterns. In patterns 1 to 5 the movable coil is suspended by a flat spiral spring (fig. 1).

In the reflecting mirror pattern the movable coil is supported by a flat metallic strip fixed at the top and the bottom (see fig. 2).

All these instruments can be used as shunted ammeters to measure currents with fair accuracy. Shunts can be provided to register currents up to 1,000 amperes. I have found pattern 4 specially handy for laboratory work. With the instrument direct and three specially prepared shunts I can measure continuously currents from $\frac{1}{10}$th milliampere to 20 amperes.

The suspended coil portable pattern can also be used as a millivolt or milliampere meter. Hence it is suitable for making conductivity tests of tram rails, or detecting faulty bonds. For this purpose a graduated bar with two steel contacts is provided. The suspended

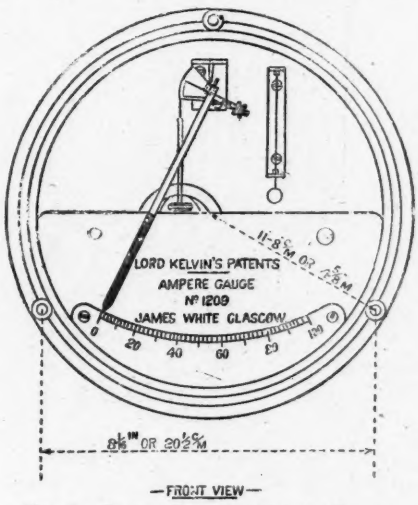


Fig. 6.—Sector Pattern Ampere Gauge.

coil voltmeter is carried in a light teak case (fig. 4). As the two steel contacts can be altered in position along the graduated bar, various degrees of sensibility can be obtained.

The suspended coil portable paralleling voltmeter (fig. 3), used with suitable sockets in the switchboard, forms a very handy method of paralleling. It is arranged with a central zero; the connections are such that the currents from the dynamo which is running and the one it is desired to put in parallel with it oppose each other, and so when the potential of the two dynamos is the same, the instrument indicates at zero.

B. 3. The ampere gauges, which were intended for use on switchboards, have had two very important improvements introduced of late years. The first improvement relates to the coil, the object of which is to obtain a coil which will give a more uniform field than it attained by ordinary methods. The coil consists of two copper tubes (two or more may be used), one smaller in diameter than the

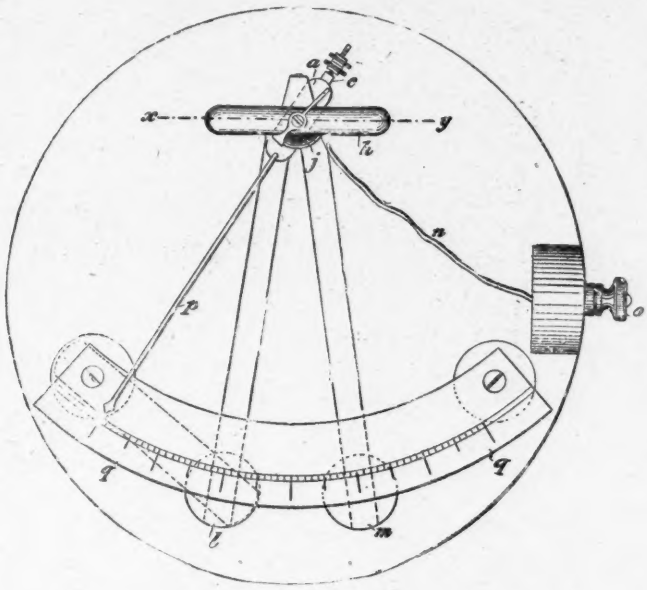


Fig. 7.—Engine Room Wattmeter: Front Elevation.

other. A spiral cut is made in each from near the top to near the bottom (see fig. 5). The spiral cuts in the two tubes are right-handed in one and left-handed in the other. The smaller tube is placed inside the other, with the space between them occupied by air or solid insulating matter. The two tubes are connected together at the top. The current goes up the copper spiral of one tube and down the spiral of the other tube. Thus a very uniform field through almost the whole length of the cylindric space within the coil is obtained. The second improvement relates to the method of suspending the soft iron plunger, which is now suspended from a sector (fig. 6). On account of the sector maintaining the movement of the plunger up and down in the same vertical straight line, it keeps the moment of the force exerted on the movable

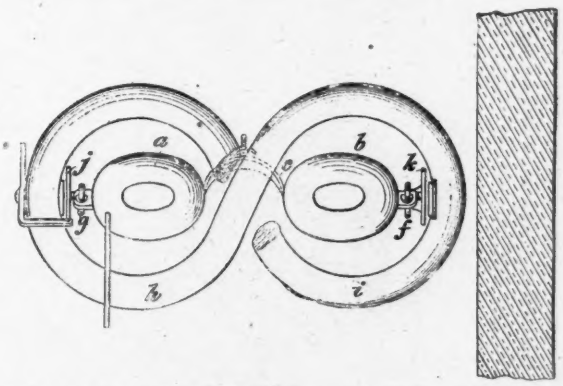


Fig. 8.—Engine Room Wattmeter: Horizontal Section of Movable System.

system always exactly proportional to the force exerted by the current on the plunger in any position. Thus there is obtained a much more evenly divided scale than in the older type.

On account of the intense field of these solenoidal coils, and the fact that the movable magnetic bar is always vertical, these instruments are not affected by switchboard currents. The ranges of the different types are such that currents from $\frac{1}{10}$ to 4,000 amperes or more can be accurately measured by them. The instruments measure the current independently of the direction in which it is flowing; but where it is desired to know the direction, as in accumulator or middle-wire circuits, a current direction indicator is fitted to the lower end of the scale. An edge-wise pattern with similar ranges of current is made.

For the ranges above 2,000 amperes the solenoid is replaced by a

simple straight horizontal conductor of sheet copper 2 or 3 millimetres thick and 4 or 5 centimetres broad in a vertical plane. The soft iron plunger is made of hair-pin shape, the conductor passing between the two ends of this plunger. The effect of the current passing through the conductor is to magnetise the plunger, one end having north and the other south polarity. As the north pole is pulled downwards on one side and the south pole on the other, the hair-pin plunger gives double the force which would be obtained by a single plunger on one side of the conductor. Besides this there is the advantage of the hair-pin shape, which allows the poles to be in close proximity to each other, very advantageously in respect to magnetisation of the horse-shoe.

C.—Electro-dynamic Instruments.

The electro-dynamic instruments are founded on the mutual forces, discovered by Ampère, between movable and fixed portions

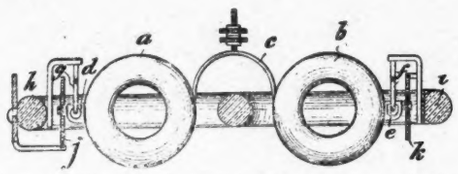


Fig. 9.—Engine Room Wattmeter: Vertical Section of Movable System.

of an electric circuit. The current instruments measure from 1 centi-ampere to 2,500 amperes, and the watt instruments measure up to 50 kw. and to 10,000 amperes. The balancing force is a weight which slides on an approximately horizontal graduated arm attached to the movable coils of the electric balances. All the ampere balances are suited for the measurement of direct or alternating current.

The new engine room wattmeter has a main circuit formed of a double rectangle of copper rod having sufficient area to carry 200 amperes, and a shunt circuit with two fine wire coils astatically arranged. The main coil is mounted on a slate back, so that the rectangles are horizontal. The shunt coils are mounted on a light but strong aluminium frame. One end of this frame has a circular knife-edge hole fixed to it, and the other end has a straight knife-edge. These two knife-edges rest on two phosphor-bronze hooks attached by insulating supports to the outside ends of the double rectangle. By this method of suspension excellent freedom from friction is obtained, while the movable system is kept in a definite position without end guides. Each fine-wire coil has about 1,000 turns of insulated wire, and its resistance is about 100 ohms. The current is conducted in and out from the movable system by two flat palladium springs, which also supply the balancing force for governing the sensibility of the instrument. Not more than one-twentieth of an ampere is allowed to pass through the fine-wire circuit, and in order to regulate this, a large non-inductive resistance is rolled on the case of the instrument, which offers a large cooling surface. The scale has nearly uniform divisions, and is graduated to read directly in watts or kilowatts as required. Fig. 7 is a front elevation; fig. 8 is a horizontal section, on the line x y of fig. 7; and fig. 9 is a vertical section showing the method of supporting the movable system.

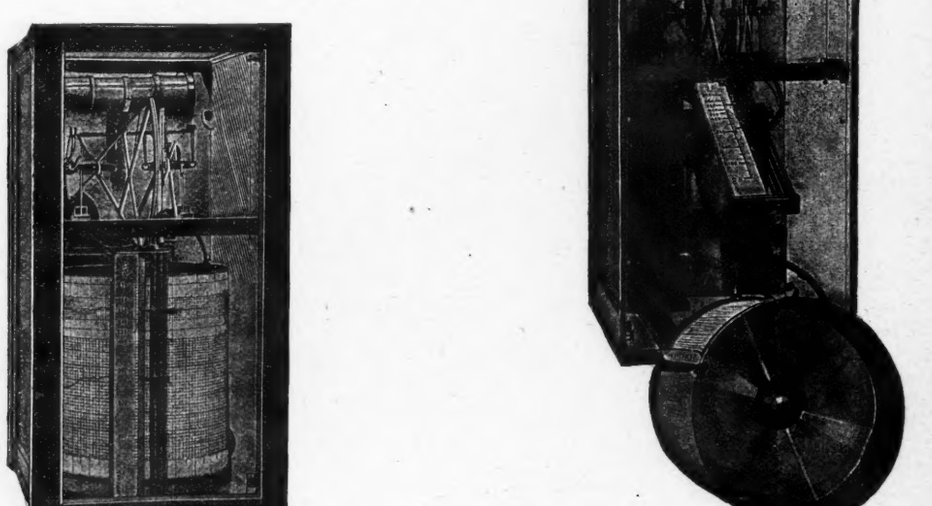
In the three-phase wattmeters there are two sets of main coils, and two sets of shunt coils. The shunt coils form the movable system. They are coupled together, and the pointer, which moves over a scale of watts or kilowatts, is rigidly attached to them. Each of the movable coils has 1,510 turns, and the resistance of each coil is 317 ohms. The number of turns and size of conductor in each of the two fixed coils vary according to the range of the instrument.

D.—Recording Instruments.

The recording instruments are amperemeters, voltmeters, and wattmeters. The recording amperemeters and voltmeters are of the ampere gauge sector pattern. A drum, round which a record paper is fixed by a metal band, is revolved by means of a clock inside it. A pen, which is attached to the lower end of the plunger, rests against the paper on the drum, with a small component of its own weight. This component is sufficient to give a good marking without introducing too much frictional error. A combination of a recording voltmeter and a recording amperemeter, called a patent feeder log, has been found very valuable in electric supply stations. There is a double sector for both the current coil and the potential coil. From one side of the double sector is suspended the soft iron plunger which moves up and down in the axis of the solenoid, and from the other end of the sector is suspended the pen which bears against the record paper. One pen marks the value of the current passing, and the other pen is arranged above it to mark on the same time line the magnitude of the difference of potential at the station, or at the feeding point. Fig. 10 shows the paper drum drawn out and turned downwards into a convenient position for changing the recording paper.

The astatic recording voltmeter for alternating currents is the same in principle as the wattmeter described above. The fixed coils are placed in a horizontal plane, and when the plane of the movable coils is at right angles to the plane of the fixed, the pointer is about 20° lower than the middle point on the scale. With the coils and pointer thus relatively placed, the scale obtained is almost perfectly uniform. The record sheets are designed to show a variation of 20 per cent. on each side of the working voltage, this variation corresponding to a movement of the pointer on either side of 12°. The external non-inductive resistance consists of electric glow lamps. The filaments of the lamps, which are arranged in series with the coils of the instruments, not only act as resistances, but owing to the temperature variation of carbon being opposite to that of copper, compensate for any change in the resistance of the coils due to temperature. The current through the lamp filaments brings them to dull red, and under these conditions the resistance is found to remain quite permanent.

The recording wattmeters differ from the astatic recording voltmeters in that the fixed coils are of copper ribbon, and carry the main current, while the movable coils, with electric lamps in series with them, take the shunt current. The mean working current through the instrument and lamps is arranged to be about one-eighth of an ampere. With this current, the working force at the middle of the scale is approximately half a gramme weight.



Closed. Fig. 10.—Feeder Log. Open.

DANGERS FROM TROLLEY WIRES AND THEIR PREVENTION.

By Prof. Andrew Jamieson, M.I.E.E., M.Inst.C.E., F.R.S.E., &c.

(Abstract of Paper read in Section IX.)

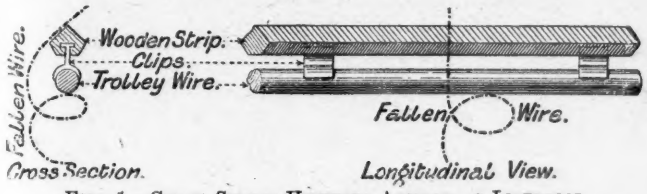
I.—Recent Accidents and the Necessity for the Proper Protection of Trolley Wires from Contact with other Overhead Conductors.

These accidents prove that so long as telephone, telegraph, and electric light wires are permitted to cross over electric tramway routes, there is a liability to their occurrence; and further, that we still lack a perfect system of guarding trolley wires from accidental contact with other conductors. There is also the danger arising from the fracture of the trolley wire and its contact with persons or animals.

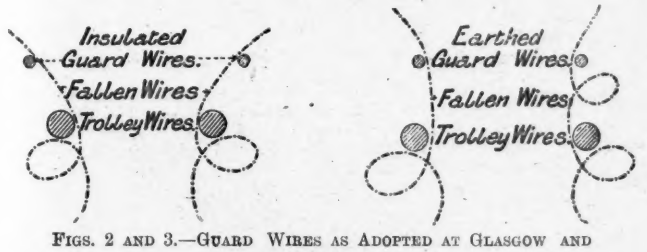
We have had in this city of Glasgow several instances of broken telephone and guard wires coming into contact with live trolley lines and producing alarming scintillations; although, fortunately, no fatal electrocutions have, so far, occurred from these causes. Many other electric tramway installations, however, both at home and abroad, supply sad instances of injury and even death.

II.—Methods which have been Adopted and Proposed for Protection against Contacts with Trolley Wires.

The form of guard adopted at Liverpool, Leeds, &c, with the view of preventing contact between the trolley wires and other broken or sagging conductors, is illustrated by figs. 1. It consists



Figs. 1.—Guard System Hitherto Adopted at Liverpool and Leeds, &c.



Figs. 2 and 3.—Guard Wires as Adopted at Glasgow and elsewhere.

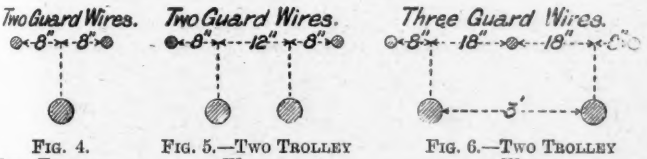


Fig. 4. One Trolley Wire.

Fig. 5.—Two Trolley Wires. Not over 12 in. apart.

Fig. 6.—Two Trolley Wires. Not over 3 ft. apart.

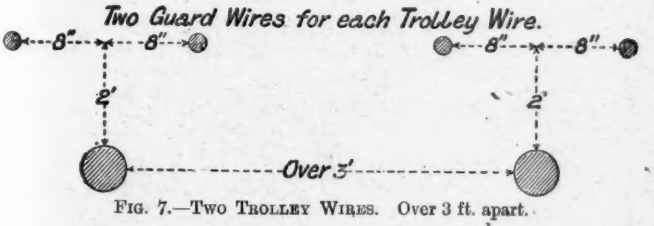


Fig. 7.—Two Trolley Wires. Over 3 ft. apart.

of strips of wood machined to the shape shown by the cross-section and supported by brass distance pieces or clips which are soldered to the upper surface of the trolley wire at convenient intervals. Although one of the cheapest, and perhaps one of the least unsightly forms in use, its inefficiency as a safeguard against fallen springy bronze telephone wires was demonstrated by the Liverpool catastrophe. The dotted lines in the cross-section and longitudinal view of the previous figures serve to indicate how the telephone wires curl and make contact with the trolley wire; or they may be dragged into connection therewith by a passing vehicle or car. In fact, to prevent the trolley wire current entering any of the fallen overhead conductors, the insulation resistance of the wooden strips would require to be great under all atmospheric conditions, the broken wires must clear the trolley wire and remain free until repaired. But such assumptions are most unlikely of fulfilment in stormy or snowy weather and where there is considerable traffic.

Figs. 2 and 3 show the two methods of arranging the guard wires which have been tried in Glasgow and many other installations. Wherever telephone or other wires are suspended above and across the trolley wires, each of the latter is guarded by *one* No. 7 S.W.G. galvanised steel wire, carried parallel to and about 2 ft. above the live car wires. At first these guard wires were insulated from earth and placed from 8 in. to 1 ft. to the left and right of the respective trolley wires. Now, however, they are earthed at the feeder pole of each half-mile section, and placed for the most part vertically above the trolley wires which they are intended to protect, as in fig. 3. But, as has been proved in actual practice, and as is shown by the dotted lines in figs. 2 and 3, the fallen springy telephone wires do make contact, not only with the guard, but also with the trolley wires. When the former were insulated, the current from the latter entered the fallen wires, and was therefore not only a great source of danger to passing human beings and animals, but has been known to set fire to telephone stations, wherein there were either no protecting fuses or inefficient ones. When the guard wires are earthed, the short piece of contact-making fallen wire is expected to melt almost instantaneously, and the street end thereof to fall harmlessly to the ground. This may happen without affecting the fuses or the automatic cut-out switches at the tramway, sub or main stations. In the case of a large number of overhead conductors, simultaneously making contact with the guard and the trolley wires, these safety devices are expected to act, and thus render the trolley wire of the section neutral and harmless.

III.—Board of Trade and Post Office Regulations.

In the Board of Trade "Electric Tramway Rules" which were issued in March, 1894, there are no regulations as to guard wires. In Form No. 2, revised and published by the Board of Trade in 1896, we find in Clause 22 the following statement regarding crossing wires:—"Where an aeriel line crosses or is in proximity to any metallic substance, precautions shall be taken by the undertakers against the possibility of the line coming into contact with the metallic substance, or of the metallic substance coming into contact with the line by breakage or otherwise."*

The regulations by the Post Office authorities for telegraph and telephone wires crossing above trolley wires, prior to August, 1901, have been as follows:—

1. "When there is only a single trolley wire or two trolley wires not more than 12 in. apart, two guard wires should be erected, as shown in figs. 4 and 5.
2. "When trolley wires are more than 12 in. apart, and do not exceed 3 ft., the guard wires should be increased to *three* in number, as shown by fig. 6.
3. "When the distance separating the trolley wires exceeds 3 ft., each wire should be separately guarded by two wires, as shown by fig. 7."

If these Post Office regulations were faithfully and carefully carried out, there can be no doubt that the chances of broken telegraph or telephone wires coming into contact with the tramway trolley wires would be minimised, and I understand that these regulations have been adopted in Bradford and other places. I am not aware of any place, where cross-lacing or hammock-netting guard wires have been introduced, as proposed by the Post Office, where the erection of telegraph or telephone wires are so close to the trolley wires, as to render the afore-mentioned protections inadequate.

IV.—Contacts Between and the Breaking of Guard and Trolley Wires.

The chief and the primary causes of such contacts and breakages arise from:—

1. The omission to turn the trolley-pole at the end of a tramcar line in the proper slanting direction for the return journey, or whenever the direction of the propulsion of a car has to be reversed. The neglect of this precaution often unships the trolley-pole from the trolley wire, and permits the former to foul the guard wire or its cross street span wire, thus severing the binding between the latter two wires, or breaking the guard wire.
2. Unshipment of the trolley pulley at street corners where the hangers are too short, or the frogs and the cast bronze (Y) or (+) brackets at crossings, are badly adjusted.
3. Disconnection between the trolley wire from hangers, splicing ears, or sectional insulators due to their imperfect soldering and clipping. Or, due to the breaking of ears, and of the trolley wire at the pinching pins of bracket crossings. (See specimens.)
4. Fusing of the trolley wire due to intermittent contact and arcing between it and a disconnected guard or span wire.

Since the guard wires are generally made of but *one* No. 7. S.W.G. galvanised steel wire (of ·18 in. diameter, having a breaking stress of less than 2,000 lbs.), whereas, the cross-street spans for the guard wires are composed of seven-strand galvanised steel wires (each wire of which is No. 14 S.W.G. of ·08 in. diameter, with a combined breaking stress of over 3,500 lbs. for the complete strand), the chances are that either the guard wire or its weak binding to the span wire is broken. Then the guard wire falls into contact

* Combined recent inspections have been made by the Post Office and the Board of Trade Electrical Engineers, with the view of formulating a joint set of rules.

with the trolley wire. If the former be insulated and originally fixed about 2 ft. above and some 8 in. to 1 ft. to the right or left of the trolley wire, it has the chance of falling clear of the same. The current may then be switched off at the nearest street pillar-box from the half-mile section in which the mishap took place, and the guard wire refixed without causing any damage. If, however, the guard wire should be earthed, either at the centre or the ends of its half-mile section, or preferably at several pole-points along the same, and if it be originally supported vertically above its trolley wire, then it naturally falls upon the latter, and the current therefrom enters the former and causes delay and trouble.

When the guard wire is only earthed at each end of a half-mile section, and contact takes place between it and the trolley wire (say about the centre of this section), then the joint resistance of the contact and the two quarter-mile lengths of guard wire may be so great, that the current passing through the contact does not increase the normal trolley wire current by an amount sufficient to blow the nearest station fuses (if there are any), or to free the automatic cut-out.

I am of the opinion that guard wires and their bindings should be made of silicon bronze instead of the usual gavanised steel. These would be stronger for the same size, and would not only have greater conductivity, but they should withstand the rapid corrosive effect which grimy chemical-laden atmospheres have upon galvanised steel wires.

It is seldom that the trolley wires break from over-tension arising from mal-erection, or even from fouling the trolley poles. They are usually composed of the very best hard-drawn 98 per cent. conductivity copper, having a diameter of ·37 in., which is equivalent to No. 3/0 S.W.G. or fully 00 B. and S. gauge. The initial stress which this wire will withstand before beginning to stretch is over 54,000 lbs., or 24 tons per sq. in. of the full section. But, when subjected to a continuous steady pull, the very small elongation of 4 per cent. is accompanied by a gradual diminution of the original cross area of fully 40 per cent. In any case, there is comparatively little chance of the trolley wire being broken by an accidental stress, except where it becomes rapidly worn at sharp street curves. Special watchfulness is therefore necessary at such curves, in order that the copper wires may be renewed before they become unduly reduced in size.

V.—Freeing, Earthing and other Safety Devices.

It is necessary to be able to render any section inoperative or "dead" as soon as possible after any one or other of the previously mentioned faults occur therein. Many devices have been proposed and adopted with this object in view, of which the following may be mentioned:—

1. Fuses and automatic cut-out switches at the supply stations. But, as we have already stated, these do not always act unless an abnormal current is demanded by a "short circuit" to "earth," or to the "return" conductor.

2. Fuses or automatic cut-out switches, or simply hand-switches, in each of the half-mile street pillar switch-boxes. There should also be a telephone, or a connection for one, in each of these boxes, in order to be able to communicate direct to the current supply stations and the engineer's office. It is unusual to place either fuses or even automatic switches in these pillar boxes, for most tramway engineers object to multiplying such devices. They therefore simply insert therein a main feeder hand-switch and a trolley wire section hand-switch for each car line, plus a telephone wire connection. Moreover, keys for opening these boxes are (as a rule) only given to the engineering staff, and consequently neither the car driver, nor the conductor, nor the car inspectors can operate these switches in case of an accident to any particular section. All that they can do under the circumstances, is to use their insulating gloves and pliers, or earth a fallen wire to the rails and communicate with the head office from the nearest special telephone pillar. This roundabout proceeding causes an unnecessary waste of time and blocking of the traffic, as well as a possible cause of danger to passengers. Why not supply these employés with keys, and give each of them clear printed instructions how to act under certain circumstances?

3. Blackwell & Co.'s "Earthing Device" is attached to either a bracket arm or a trolley wire suspension, and it acts when the trolley wire breaks, by mechanically short-circuiting it to the rails.

4. Placing an earthing switch in each car. In the case of the severance or disconnection of a trolley wire, or a serious downfall of overhead conductors, all that the driver or the guard has to do, is to break the glass front of a special box and turn a switch or insert a plug into a metal hole, thus immediately earthing the trolley wire to the tramway rails through the trolley pole and car wheels. This operation instantly causes an abnormal current to flow in the feeder to the section in which the car happens to be at the time, and consequently blows its safety fuse or frees its automatic switch at the station. This device, which is being tried in Leeds, seems to me to be one of the simplest and most direct methods of rendering a section neutral in the case of an emergency. The attendant at the station should be authorised to close the freed automatic circuit-breaker, three successive times; when, should it persistently and immediately fly out again, he must attend to the telephone for instructions before again closing the switch.

VII.—Aerial Telephone and Telegraph Cables versus Underground Wires or Cables.

In Glasgow there are now three authorities dealing with these important matters, viz.:—

1. The Government Postal Engineering Department, who have placed their principal telegraph and telephone city wires underground, but who have still a large number of aerial wires.

2. The National Telephone Company, who have hitherto carried their fine bronze wires overhead, and who, being prevented from opening the streets, are now running aerial telephone cables. Such cables and their suspension spans are not likely to interfere with tramway trolley wires; and even if they did come down in the case of a fire, they are so large, well insulated, and strong that they could be more readily dealt with than a similar number of bare bronze springy wires.

3. The Corporation of Glasgow, who have just started a telephone exchange, and who, having full authority in regard to their streets, have very properly taken the precaution to place all their city wires and cables in underground cast-iron pipes where they approach the tramway lines.

There cannot be the slightest doubt that the only sure and safe plan is to place all non-tramway electrical conductors of whatever kind underground. If this were done, then there would be no necessity for guard wires, thereby leaving the trolley wires free from extraneous contacts, and minimising the afore-mentioned dangers.

STANDARD ENGINE TESTS.

The American Society of Mechanical Engineers appointed a Committee to codify and standardise the methods of engine tests, and their report was presented at the May meeting of the Society in Milwaukee.

The object kept before them by the Committee was to secure a plan of such breadth that it will be of service to the owner and not merely a so-called scientific investigation. For example, attention has been given to combined or overall tests of both engine and boiler, for, after all, this is the point that appeals to a steam user.

The Committee recommend that when an engine is operated at its rated power at a given pressure, it should have a reserve to allow a drop of 25 per cent. in the steam pressure without sensible reduction in its speed.

This is in a sense sound enough, but it does not spell economy. An underloaded engine is far from economical, and we should rather aim to be possessed of such appliances as would force steam production than waste steam constantly by an over large engine. The question is, of course, largely to be determined by environment.

No specific rules are laid down as to preparations. If questions of contract are to be settled they should be clearly stated in writing. Generally all preparations should vary the *régime* of the plant as little as possible. In any case, whatever the object of the test, it should be ascertained and plainly stated.

Secondly, the plant should be inspected and examined for tightness, and details of means are given for arriving at some of the results sought.

Thirdly, cylinder dimensions and clearances must be measured, or otherwise ascertained as closely as possible, the water method being recommended as the best whereby to ascertain clearance.

Fourthly, the coal must be known.

Fifthly, all apparatus must be calibrated with standards, especially if a water meter be employed.

Sixthly, all leakage of steam and water must be known, unless, as regards the engine, the discharge of condensed steam can be measured.

Seventhly, it is recommended that a test should be run for 24 hours, whether the engine be in motion or not. This, of course, enables all influences to be estimated.

Eighthly, it is advised that a test should commence with a flying start, just when things are normal, and not simply at a given minute.

This is a good system, for if fractional minutes are objected to, they can be eliminated by setting the clock to a full minute at the starting signal, so as to eliminate the fractions. Obviously a start and a stop should coincide with a fire cleaning period, and we have found it a good practice, as far as possible, to start and stop in such a way as to cut out the personal equation of the fireman. To do this, it is necessary to have as much coal as usual on the floor, so that the fireman is not unconsciously influenced by the smallness of the final heap before him. It is better to have a quantity to weigh back if an "actual conditions" test is to be run.

Clause IX. deals with heat consumption, which must or must not include auxiliaries according to whether they are properly part of a contractor's guaranteed plant or otherwise. There are numerous other clauses.

BUSINESS NOTES.

Cork Exhibition.—An International Exhibition is to be held at Cork from May to November next year, and particulars as to available space, &c., may be obtained from Mr. R. A. Atkins, the hon. secretary, at Municipal Buildings, Cork, by October 31st.

Northampton Institute.—The book of announcements for the 1901—2 session at the Northampton Institute, E.C., has been sent to us by Mr. R. Mullineux Walmsley, the principal. It gives full details regarding all the arrangements, both educational and social; the mechanical and electrical engineering lectures and classes are a special feature.

Electrical Wares Exported.

Week Ending Sept. 4th, 1900.		Week ending Sept. 3rd, 1901.	
Adelaide	Value £67	Adelaide	Value £183
Aden. Teleg. apparatus ..	40	Amsterdam	50
Amsterdam	148	Barcelona	40
Auckland	714	Bombay	32
Bangkok	110	Buenos Ayres	54
Beira. Teleg. mat.	44	,, Teleg. mat. ..	385
Bombay	141	Calcutta	431
Bordeaux	80	Cape Town	199
Boulogne. Elec. cabs	150	Channel Islands. Teleg. mat.	207
Buenos Ayres. Elec. cable ..	725	Chinde	12
,, Teleg. mat. ..	268	Christiania. Teleg. wire ..	72
Calcutta	573	Colombo	46
,, Teleg. wire	98	Copenhagen. Teleg. wire ..	150
Cape Town	16	Durban	818
Colombo	81	,, Teleph mat.	332
Durban	388	Fremantle	126
East London	78	,, Teleg. mat. ..	6,114
Flushing	16	Gothenburg	79
Fremantle	60	Hamburg	301
Halifax	20	,, Teleg. mat.	60
Hamburg	110	Hong Kong	39
Hong Kong	9	Lisbon. Teleg. mat.	48
Jamaica. Teleg. mat.	59	Melbourne	117
Karachi	123	,, Telephones	56
Kobe	33	North Sea. Teleg. cable ..	13,000
Launceston	214	Penang	18
Libau	330	Perth	50
Lyttleton	697	,, Teleg. cable ..	268,000
Madras	43	,, Teleg. mat.	4,924
Malta	29	Port Elizabeth. Teleg mat. ..	75
Melbourne	458	St. Petersburg	100
,, Teleg. mat.	900	Santa Cruz	27
Port Elizabeth	103	Santos	525
RioJaneiro. Teleg. cable & mat.	188,592	Shanghai	21
Rotterdam. Teleg. mat. ..	46	Stockholm. Teleg. wire ..	126
St. Petersburg	184	,, Teleph. cable ..	457
Seville	280	Sydney	1,268
Shanghai	35	Wellington	880
Singapore	111	Yokohama	4,862
Stockholm. Teleg. mat. ..	242		
Sydney	1,118		
,, Teleg. mat.	404		
Tokio. Teleg. cable	135		
Trinidad	37		
Wellington	80		
,, Teleg. cable ..	387		
,, Telephones ..	293		
Yokohama	579		
,, Teleg. apparatus ..	11,946		
Total ..	£211,031	Total ..	£304,224

Foreign Goods Transhipped.

Gothenburg. Elec. goods	Value £40	Durban. Elec. mfts. ..	Value £194
Stockholm. Elec. mat.	103	,, Elec. lamps	53
Yokohama. Elec. mat.	10	Paris. Elec. mat.	93
Total	£153	Total	£340

Blackpool Electric Tramways (South Company).—On Wednesday, in the Vacation Court of the High Court of Justice, before Mr. Justice Joyce, a motion was heard in the matter of the Companies' Acts, 1900, in the matter of the Blackpool Electric Tramways (South Company), and in the matter of a trust deed dated July 11th, 1901, &c., for extension of time. Mr. Mossop said it was an application on a notice of motion by the secretary of the company, under Sec. 15 of the Act, which gave his Lordship power to extend the time for registration if his Lordship were satisfied that the omission to register was accidental or due to inadvertence, or that leave to extend the time would not prejudice the shareholders. It was a debenture trust deed of the company which was made by resolution of July 11th, which ought to have been registered within 21 days of that date. As a fact, the debenture trust deed was approved by the directors, and it was intended at the same time to register the trust deed and the debentures, but the debentures were not printed, and it took a longer time to print and have them signed and sealed than the secretary thought it would have done. As a result the time for registration of 1,500 debentures of £100 each within 21 days of the execution of the trust deed expired. Counsel asked that the time for registration should be extended. His Lordship granted the order asked for.

Catalogues and Lists.—We have received from Mr. Edwin Barnes, of 15, Charterhouse Street, Holborn Circus, E.C., a list of electric light fittings and other art metal work in the style known as "l'art nouveau," which is claimed to lend itself well to antique bronzes. Mr. Barnes is a manufacturers' agent, and represents Messrs. Edwards & Marsden, electric light and gas fitting manufacturers, of Birmingham, and at the new showrooms just opened at the above address he has on exhibition a large selection of their specialities. All fittings shown in the list are hand-wrought. Oxidised silver and antique brass are a special line of Messrs. Edwards & Marsden's.

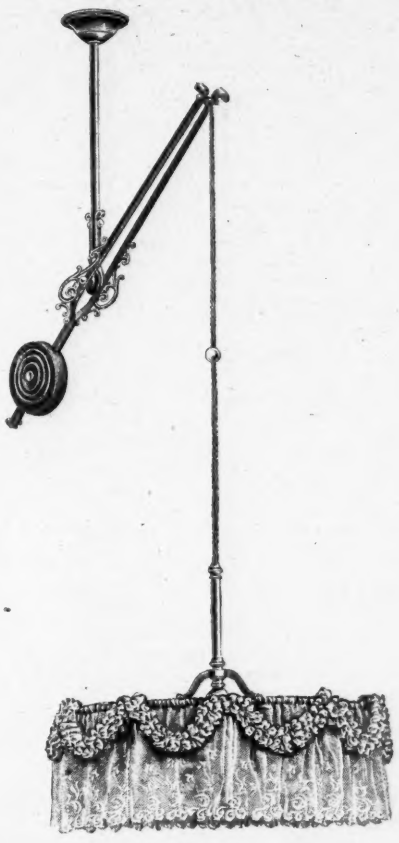
Two small lists are to hand from the Jandus Electric Company, of Cleveland, Ohio, giving some pretty illustrations of the Jandus arc lamps and electric fans.

Dissolutions and Liquidations.—Creditors of the Bute Electrical Manufacturing Company must send details of debts or claims to the liquidator (R. Leyshon, 12, Mount Stuart Square, Cardiff) by September 30th.

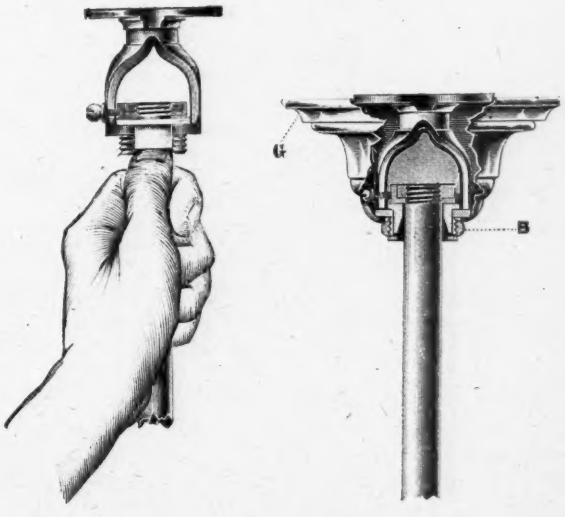
Messrs. A. Pollock & G. Bellgowan (Pollock Electric Alarm Company, Middlesboro', and National Electric Alarm Company, Kingston-upon-Hull) have dissolved partnership. In future Mr. A. Pollock will carry on the Pollock Company, and Mr. Bellgowan, the National Company, and each will attend to the debts, &c., of his own company.

Finsen Light for Lupus.—Almost simultaneously with Dr. Bang's improvements, Mr. T. J. Smith, of the London Hospital, has invented a new lamp to supersede the complicated Finsen lamp, and to greatly reduce the time required for treatment.

The Electric "Surprise" Pendant.—Messrs. Best and Lloyd, of Handsworth, Birmingham, whose "Surprise" pendant is so well and favourably known by gas users, have now brought out a new pendant on the same lines for electric lighting, particulars of which are just to hand. The difficulty of adapting the gas fitting for electrical purposes in an economical way, lay in the



arrangements for wiring, so as to prevent trouble by short circuits or breaking of wires. The new electric "Surprise" gets over these difficulties in a simple way and provides a fitting equally adapted in its various styles for workshop or drawing room. The light can be adjusted by a mere finger-touch to play upon any desired point within a circle of about 3 ft.



diameter and at any required height. An important point is the perfect insulation of every point where the flexible comes in contact with the fitting, while an ingenious arrangement prevents any possibility of the pendant being overturned in such a way as to break the flex. The ceiling fitting is such that it can be screwed to conduit tube, screwed to ceiling block, or hung from ceiling hook

without any alteration whatever, as will be seen from the illustrations. The pivotting point is carefully insulated, while at the end of the bracket the flex is run through an insulator, which pivots freely, and so prevents abrasion. The screw shown in the second illustration, besides holding the insulating collar and rod work in position, is arranged so as to form a check to further revolution of the rod work when it has completed 1¾ turns in either direction. The method of fixing is simple in the extreme, and the wiring presents no difficulty whatever, being simple, straightforward work. We illustrate the two or three-light fitting, D 4. The length of main tube is varied to suit very high or very low rooms or offices. For the drawing office we consider the "Surprise" a most useful fitting, as its range of movement enables the light to be brought right over the draughtsman's work.

German Electrical Companies.—The Berlin correspondent of the *Financial News* says that there exist in Germany, according to recent statistics, 22 electricity concerns, with a capital of £104,250,000 in shares and £5,750,000 in debentures; 14 trusts, with £8,650,000 in shares and £5,350,000 in debentures; 39 electric railways, with £1,510,000 in shares and £7,850,000 in debentures. The first category's last dividend amounted to an average of 8·9 per cent., the trusts yielded 4·5 per cent., the railways 9·2 per cent., and the central electricity stations (of which nine are in existence, with a capital of £3,750,000 in shares and £2,200,000 in debentures) 7·8 per cent. Altogether, these 84 above-mentioned concerns have absorbed 835,000,000 marks in shares and 425,000,000 marks in 4 and 4½ per cent. debentures.

Outing.—On Saturday last, to celebrate the opening of the Corporation telephone system, the Glasgow staff of the British Insulated Wire Company, who are the principal contractors, went for a trip to Ayr. Part of the day was spent in sports and drives to Burns's Monument, &c. In the morning a few of the party visited the Ayr Corporation electricity works, over which they were courteously shown by the chief engineer, Mr. Fuller. Dinner and tea were served at the Ayr Arms Hotel, where about 50 sat down, presided over by Mr. J. Venn.

Russian Electrical Undertakings.—The *Financial Times* says that the Russian Schuckert Electrical Company of St. Petersburg has not been long in following the example of its parent, the German Schuckert Company, of Nuremberg, in passing its dividend. A short time ago the German company proposed a dividend at the rate of 10 per cent. on its capital of £2,100,000, but the recommendation was entirely withdrawn at the recent meeting, because the company had been compelled to pay immediately to the Leipsig Bank (prior to its collapse) the sum of £210,000, in order to obtain possession of shares to that amount in the Jaice Electrical Company, which is engaged in the electrical production of carbide of calcium in Austria, and is not in a satisfactory condition. The Russian Schuckert Company, in which the German company is interested to the extent of £144,000, has a capital of £317,000, and the surplus for the past year amounts to only £22,780, which is to be carried forward to the next account. It had been anticipated by the parent company that its offspring, with its branches in Moscow, Kieff and Odessa, would yield a return of 5 per cent. on its capital, but this expectation has been unfulfilled. The negotiations which have been proceeding for some time past between the three electric supply companies in St. Petersburg have now been brought to a successful issue, whereby a uniform system of charging will come into force in the autumn. Under agreements entered into with the municipal authorities, the Electric Lighting Company of 1896, the Petersburg (Helios) Company for Electric Installations and the Eclairage Electrique de St. Petersbourg were authorised to charge consumers at the rate of 3½ copecks per hectowatt-hour, but the price has varied from as low as 1·8 copecks to 2·5 copecks. In future, however, the charge by each company will be 3½ copecks, as provided under the concessions, and thus the competition prevailing in the past will be avoided. The directors of the St. Petersburg Shore Railway Company have been authorised to consider the question of introducing electric traction on the line. A scheme for this purpose has already been submitted by the Lahmeyer Company, of Frankfort-on-the-Maine, which is supplying 25,000 H.P. of electrical machinery for the Charing Cross and City Electric Lighting Company, and in the event of the railway company deciding to make the change it is reported that the contract will be given to the Frankfort Company in question.

Trade Announcements.—The Pulsometer Engineering Company, Limited, have removed their works and offices from Nine Elms, S.W., to Nine Elms Iron Works, Reading, Berks. The offices and showroom at 63, Queen Victoria Street, E.C., are still retained. Some 12 acres of land have been acquired at Reading, which town is considered to possess special advantages for carrying on the company's business. The factory which has been erected there is, of course, modern in design and equipment, and prompt delivery is expected to be one of the great benefits resulting therefrom.

Messrs. J. C. Lyell & Co. advise us that Messrs. E. B. Spurrier and Co., of 14, Coldra Road, Newport, Mon., are no longer their agents, nor are they authorised to represent the company in any way.

Messrs. Jaeger Bros., of Schalksmühle, inform us that Messrs. A. Vandam & Co. are no longer their sole selling agents for holders, switches, and other electric fittings. They have opened their own offices at 39, Victoria Street, S.W., and all future inquiries should be sent to them at that address.

ELECTRIC LIGHT AND POWER NOTES.

Auckland.—The City Council has resolved to carry out an electric lighting scheme.

Barnsley.—The Lighting Committee is accepting tenders for condensers for the electricity works.

Blyth.—A commencement has been made by the Northern Counties' Electricity Supply Company, Limited, with the cable laying, and the supply is expected to be ready early in October.

Bolton.—After receiving a report from the borough electrical engineer (Mr. A. A. Day), the Electricity Committee resolved that application should be made to the L.G.B. for sanction to borrow a further sum of £125,000 for electrical purposes.

Brighouse.—The T.C. has adopted a report by Messrs. Lacey, Clirehugh & Sillar, recommending that the mains be increased in size to reduce the loss in transmission.

Cleckheaton.—Messrs. Gibbings & Baker have prepared specifications for an electricity supply station for the D.C. Energy will be supplied from the same works for the tramways.

Cowes.—The 1896 Electric Lighting Order has been revoked by the B. of T.

Doncaster.—For the post vacated by Mr. Prussman, who goes to Swansea, there were 50 applicants. The T.C. selected five candidates for an interview, and Mr. Wild was appointed.

Dover.—As a result of the recent international postal conference, says the *Times*, the first of the new time-saving appliances for transhipping mails and baggage in connection with cross-Channel service at Dover was brought into operation last week. An electric travelling gangway was used between the mail steamers and the shore with the most successful results. The gangway, which is on the principle of an endless platform, brought packages of any weight on shore at the rate of one in 15 seconds, when only working at moderate speed, and at a sharp incline caused by the low tide. Some of the packages weighed as much as 7 cwt. Half the ordinary time was saved on trans-shipment.

Enfield. — The North Metropolitan Electric Power Company has sent in proposals with regard to the supply of electrical energy to the D.C.

Farnworth.—The electrical installation of the U.D.C. was formally opened on 28th ult. The undertaking has cost about £22,000, and includes both lighting and traction.

Festiniog.—The D.C. has accepted an agreement with the Yale Electric Company for the electric lighting of the district.

Ingleton.—The B. of T. has renewed the 1899 electric lighting license for two years.

Kimberley.—In our issue of July 12th we printed in this column an extract from the *British and South African Export Gazette*, in which it was stated that the directors of the De Beers Consolidated Mines had in hand enormous extensions of their electric light and power system; that they were going to supply the Town Council at net cost, and that the contracts would go to America. Mr. Granville Vines, however, borough electrical engineer to the Kimberley T.C., informs us that these statements are very wide of the truth. The total capital outlay will be £200,000, and the horse-power about 10,000; the T.C. knows nothing of the alleged arrangement for the supply to the town, and so far from the contracts being placed abroad, the turbo-alternators have been ordered from Messrs. C. A. Parsons, the boilers from Messrs. Babcock and Wilcox (Glasgow), and the cables are sure to be placed with an English firm. We are pleased to make these corrections, especially as regards the contracts.

The engineer recently reported to the T.C. that the street lighting cost more in wages than the private lighting, although the latter required four times the power of the former, and the street lighting plant was only used 17 days per month; he recommended that the two systems should be amalgamated, effecting a saving estimated at £1,200 per annum. Extensions of the plant were also recommended and approved. The T.C. has resolved to allow 5 per cent. for depreciation, 1 per cent. for sinking fund, and 4 per cent. for interest on the capital outlay.

Limerick.—The T.C. has decided to consult Prof. Kennedy regarding the electric lighting scheme, and to invite fresh tenders.

Llandudno.—The L.G.B. has sanctioned the raising of £1,027 by the D.C. for electric lighting purposes.

A proposal by the Electric Lighting Committee to reduce the charge for electricity to large consumers has been referred back.

Methley.—The Yorkshire Electric Power Syndicate are about to proceed with the erection of their first generating station (50,000 H.P.) at Methley, plans and specifications for which are now being got out.

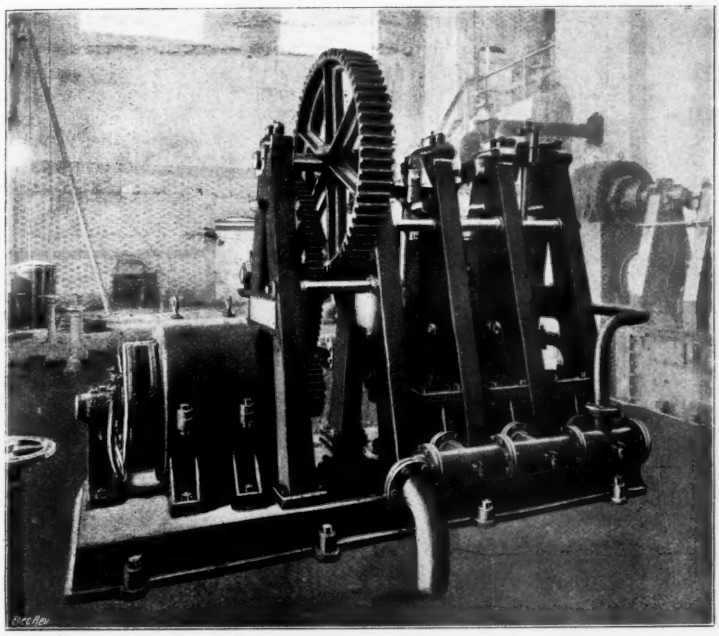
Nottingham.—The electric lighting of the new Sanatorium for consumption, has been entrusted to Mr. W. J. Furse, Nottingham. The same firm is also carrying out the whole of the public lighting for the Corporation electric tramways.

(Continued on page 397.)

GLASGOW ELECTRIC TRAMWAYS.

(*Continued from page* 352.)

Glasgow is well supplied with water from Loch Katrine, which is equally excellent both for drinking and steaming purposes, so that no provision has had to be made for softening the water. The boilers are fed from two large storage tanks situated between the two chimneys, which are supplied from the ordinary public water service. These tanks, which measure 25 ft. by 12 ft. by 10 ft., contain 18,000 gallons each. The feed-water is forced into the boilers by five electrically-driven feed pumps, made by the Mirrlees Watson Company, Limited, operated by Bruce Peebles motors, and one steam-driven feed pump by G. & J. Weir, Limited, of Glasgow. Each of the former pumps is capable of delivering 8,000 gallons per hour, against a boiler pressure of 180 lbs. per sq. in., and the Weir pump is capable of delivering 16,000 gallons of water per hour against the same pressure.



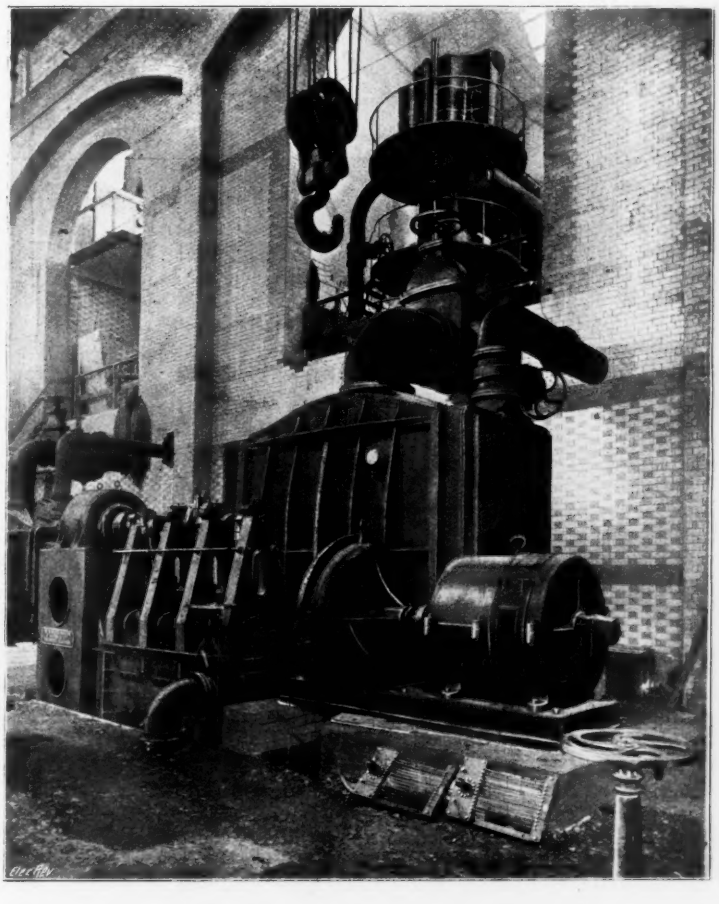
Electrically-Driven Feed Pump.

The feed piping consists of wrought-iron lap-welded pipes, 4 in., 5 in. and 6 in. in diameter. Duplicate mains, coming from the pumps, feed through water meters and filters to a central 6-in. ring, which again delivers either through the economisers to 5-in. rings surrounding the boilers or direct to the boilers.

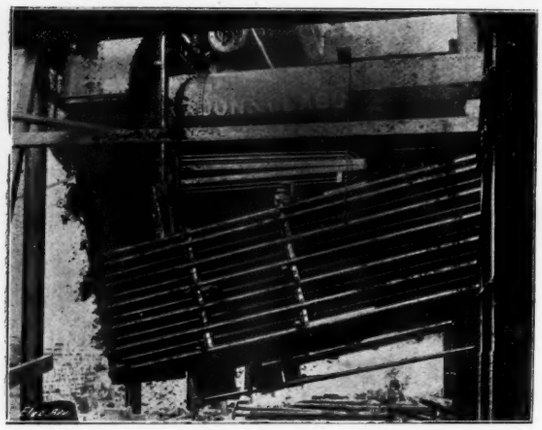
The feed pipes are arranged so that the pumps may draw either from the storage tanks or from the hot wells; the latter are also provided with a supplementary water service.

In dealing with the large quantity of exhaust steam which results from the working of a big power station, such as that at Pinkston, it is not only necessary to provide an efficient and trustworthy set of condensers, but it is also very important that floor space should be economised and utilised to the greatest advantage. The condensers installed at Pinkston were designed with this object in view, hence their neat and compact appearance. The larger one, shown in our illustration, is capable of condensing 60,000 lbs. of steam per hour, and the smaller one, 24,000 lbs. of steam per hour. Four of the larger, one for each main engine, and one of the smaller size for the two auxiliary engines, were supplied by the Mirrlees Watson Company. The condensers, which are rectangular in plan, have thick cast-iron shells, strengthened by a network of ribs. The tube plates are of rolled brass, with solid-drawn brass tubes, expanded at one end, and packed with cotton wick set up with screwed ferrules at the other. The larger condenser contains 2,690 of these tubes, and the smaller 1,072; the water has a double circulation through the nest of tubes.

In front of the condensers are four Edwards three-throw air pumps, manufactured by the Mirrlees Watson Company, Limited, which have a very high efficiency, and dispense with foot and bucket valves. Each set of pumps is run in connection with one of the large condensers, and is capable of dealing with 60,000 lbs. of exhaust steam per hour. The arrangement for driving, as our illustration shows, is of the simplest description. A low-speed electric motor, made by Messrs. D. Bruce Peebles & Co., is coupled up direct to the crankshaft, and in this way all waste of power, due to transmission through a series of spur wheels or other speed-reducing devices, is effectively avoided. Besides this, the above arrangement provides a neat and compact machine, occupying a minimum of floor space. The pumps have 16-in. diameter buckets, with a stroke of 12 in., and the crankshaft



Surface Condenser, Air Pump, and Circulating Pump.

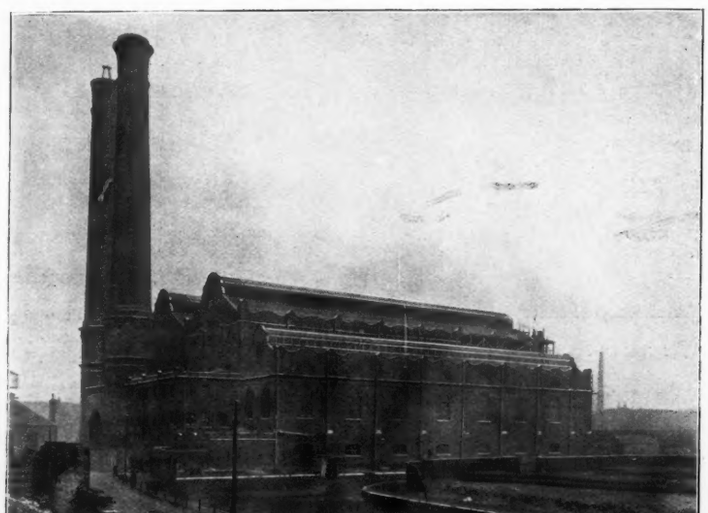


Water-tube Boiler showing Scotch Furnace & Superheater.

runs at 150 revolutions per minute. The electric motor is connected to the 500-volt power circuit.

Besides the four larger air pumps, there is also a small pump for the auxiliary condenser, 11 in. diameter × 10 in. stroke, of similar design to those described above. This set can deal with 24,000 lbs. of exhaust steam per hour, and, like the larger size, its motor runs at a speed of 150 revolutions per minute.

The main exhaust pipe is a riveted mild steel pipe, 40 in. diameter, which connects direct to the atmosphere.



Exterior of Power Station, showing Canal.

The exhaust branches from the engines are 27 in. and 30 in. in diameter respectively, of cast-iron, and are arranged to deliver either direct to the atmospheric exhaust or to the surface condensers. Cast-iron expansion joints are provided in the 40 in. main, and Webster's oil separators are fitted in the 27 in. and 30 in. mains, as well as automatic relief valves.

A separate centrifugal circulating pump is provided for each of the condensers; the larger ones have a delivery of 240,000 gallons per hour, while the small one connected with the auxiliary condenser delivers 96,000 gallons per hour. Each of these has a separate suction pipe from the canal; the pipes are of cast-iron, 15 in. in diameter for the main condensers, and 10 in. for the auxiliary condenser. The discharge pipes are also of cast-iron, and connect from each condenser to a main running back to the canal.

These pumps were supplied by Messrs. Mavor & Coulson, Limited, and are direct coupled to enclosed motors of their own manufacture.

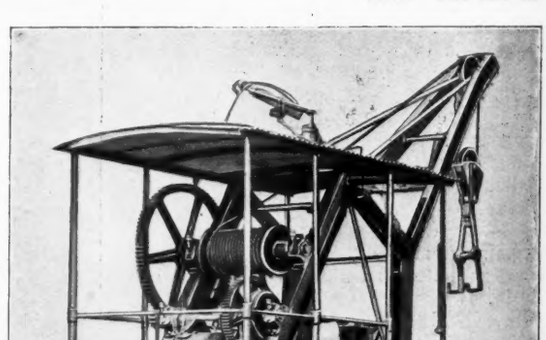
Before passing on to the electrical plant, we should mention that the railway wagons which bring coal to the station are handled by an electric crane, supplied by Messrs. J. Carrick & Sons. This crane, of which we give an illustration, is electrically operated by means of four Westinghouse traction motors—two of 35 H.P. for travelling, with series parallel controller; one of 35 H.P. for lifting, and one of 10 H.P. for swinging, the latter having worm and wheel reduction gear. The crane has a lifting power of 10 tons, and is used for tilting up one end of a wagon so as to tip the coal into the receiving hopper. The weight of the whole apparatus is 25 tons.

The four main generators supplied by the British Thomson-Houston Company, Limited, are of the three-phase "A. T. B. 40" type, each rated at 2,500 KW. at 6,500 volts, 25 cycles per second.

The armature is stationary, and the frame (of cast-steel) is arranged for moving sideways along the shaft. The armature core is built up of sheet-iron punchings of high permeability and low hysteresis, with rectangular slots in their inner circumference. Ventilating spaces are left in the core to allow a free circulation of air through it and round the windings. The armature winding consists of separate coils, formed and insulated before assembling, and is star connected, with two circuits per phase; it comprises 120 coils, each coil having 18 turns. The conductor consists of pressed cable, ·485 in. × ·235 in. in section, triple cotton-covered. The coils are held in the slots by wooden wedges, and are protected from mechanical injury by a cast-iron shield fastened to the frame, which shield also encloses and protects the connections from coil to coil.

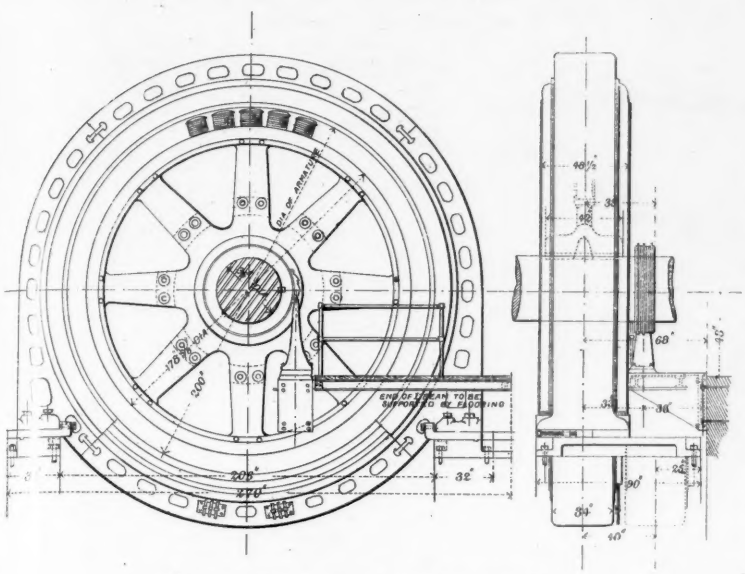
The 40 pole-pieces of the revolving field are built up of high permeability sheet-iron, securely fastened to the steel ring of the revolving field. The winding consists of 40 coils connected in series, and designed for an excitation voltage of 100 volts. Each coil has 43 turns of copper strip, measuring ·17 in. × $1\frac{5}{8}$ in., wound on edge.

The normal excitation of the field with full non-inductive load requires approximately 250 amperes at a pressure of 100 volts. The rise in



Electric Crane for Handling Coal.

temperature after a 12 hours' run is not to be greater than 30° C. in any part of the generator when measured by thermometer, and the machine is capable of



Side and End Elevations of Alternator.

carrying 25 per cent. overload for two hours, or 50 per cent. overload for 15 minutes, without injury.

The direct current auxiliary generators are of the M.P. 10-pole type, each rated at 600 KW. at 500 to 600 volts.

The generators are suitable for operation as shunt machines at 500 volts no load and full load, and as compound machines at 500 volts no load and 600 volts full load, and are mounted directly upon the engine shafts.

The fields are circular, of cast-iron, with 10 inwardly projecting removable poles of high-grade cast-steel. The field coils are wound separately on malleable iron spools, and are well insulated with veneer board and oiled cotton.

The armature is of the iron-clad slotted-core type, wound with copper bars, laid in slots and insulated from the armature core by means of alternate layers of oiled linen and paper. The punchings are keyed in the cast-iron spider in such a way that no bolts pass through the core. The end connections are of the barrel type, and are supported by and bound down upon extensions of the armature spider. The construction affords good mechanical protection and minimises the liability of damage from dust and oil.

The commutator is supported on an extension of the armature spider, so that it is integral with the armature. The bars are of hard-drawn copper, insulated from each other and from the spider by means of the best quality of sheet mica.

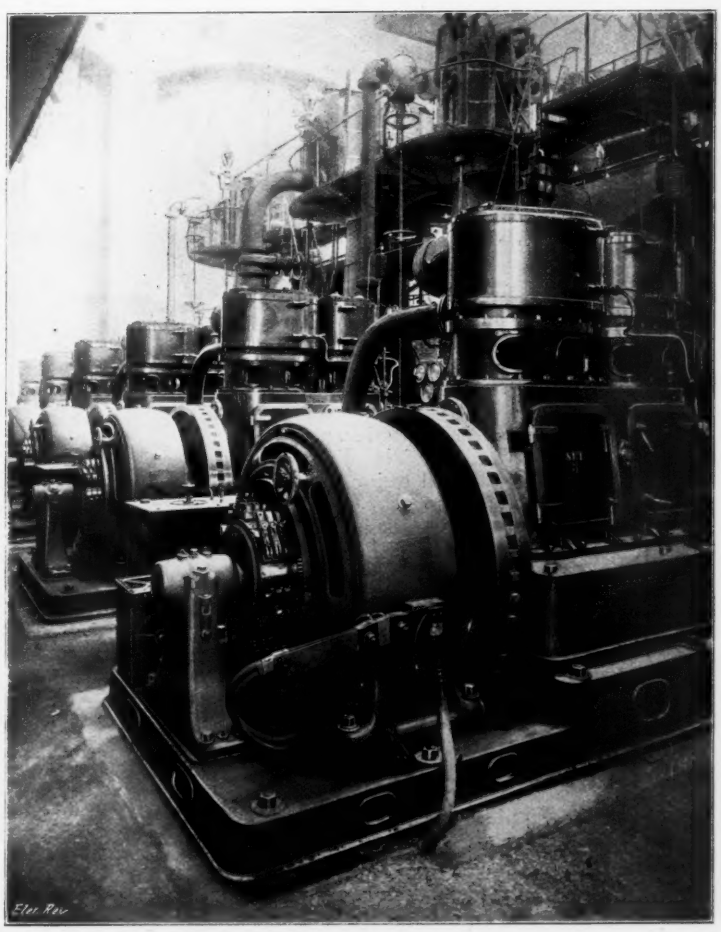
After 24 hours' run at rated load the temperature of armature and field coils, as measured by thermometer, is not to be more than 30° C., and the commutator not more than 45° C., above the surrounding atmosphere, the latter being assumed to be 25° C. The machine will carry an overload of 25 per cent. for one hour without movement of the brushes or appreciable sparking, and 50 per cent. overload temporarily without flashing over or injurious sparking.

The exciters are of the M.P. six-pole type, each giving 50 KW. at 300 revolutions per minute at 100 volts. Their construction is practically the same in all respects as that of the larger machines described above.

The fields are shunt wound for a pressure of 100 volts no load and full load. The overload and temperature specifications are also the same as those detailed above.

The switchboards at the power station were all supplied by the British Westinghouse Company, and, as might be supposed, are very extensive. The main switchboard, which consists of 34 panels, is mounted on a gallery; the feeder switch gear is placed behind the main board, in what is practically a separate room. An auxiliary switchboard is placed in the engine room floor level, beneath the main switchboard gallery, and contains apparatus for the control of the auxiliary direct-current generators, for 12 feeders, and for 18 power circuits for the works, as well as a panel for the station lighting. This board, of which we give a view, is used for controlling the light night load. Each of the panels for the auxiliary generators is equipped with two 1,200-ampere main switches, a double-pole field switch, field ammeter and rheostat, an automatic maximum current circuit breaker, and voltmeter plug connections.

Four panels are provided for the night load feeders, each equipped with three circuit breakers, three ammeters, and three single-pole two-way switches. From these panels 12 feeders run to the different depôts.



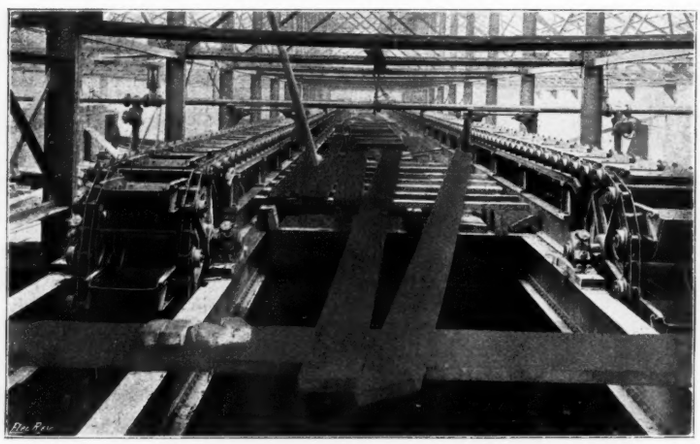
B.T.H. Exciters and Allen Engines.

There are also three panels for the station power circuits.

(To be continued.)

GLASGOW CORPORATION TELEPHONES.

Although this system has been in operation since the end of March, the formal inauguration did not take place till Thursday last week. The Lord Provost (Samuel Chisholm, Esq., LL.D.) declared the Exchange open in the presence of a distinguished company, among them being the Rt. Hon. R. W. Hanbury, who later in the day received the honour of the freedom of the city.



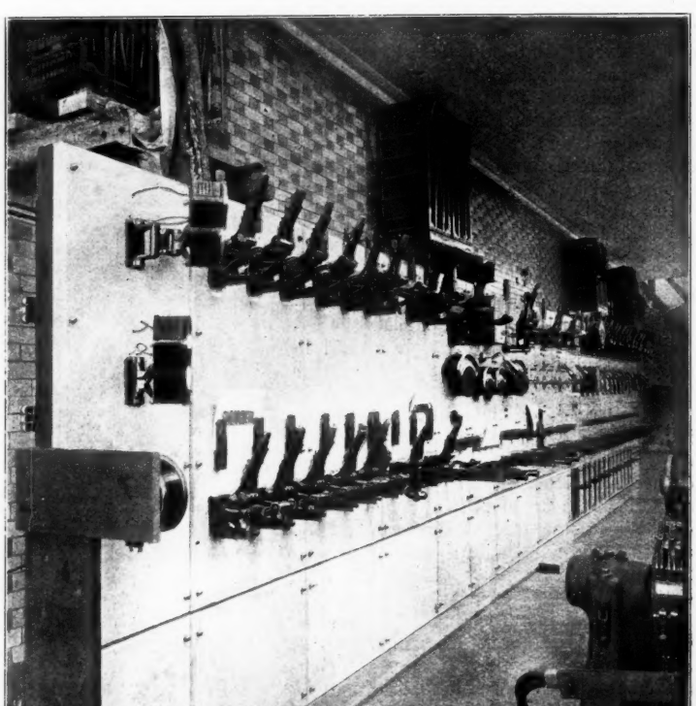
Glasgow Tramways: View of Conveyors over the Boiler House.

There are now 1,474 subscribers connected out of a list of 5,400, and the remainder are being connected at the rate of 25 to 30 per day. The ultimate area to be served extends to some 140 square miles, and includes Clydebank, Govan, Partick, Kirkintilloch and Kilsyth. Up to date 52 miles of trenches and 77 miles of piping have been laid, all the conductors being underground. The cables consist of from 8 to 312 pairs of wires, No. 22 S.W.G., paper insulated to reduce the inductive capacity, and surrounded by a stout lead outside tube, this lead being protected by the trenches and cast-iron pipes referred to. In all some 16,500 miles of single wire have now been laid. Manholes, similar to the type adopted for electric light mains, are placed at convenient distances. For cross-connecting, or where a pair of wires requires to be taken from one cable to another, a cast-iron water-tight and air-tight distributing box is used, the lead casing of the cables being sweated to gun-metal glands already secured to the boxes so as to ensure perfect air-tightness. From the street the cables are brought up the wall to a test room on the fifth floor of the exchange. Each wire is here connected to a test jack, which forms a ready means of showing whether any fault occurring is outside or inside the exchange building.

The test jack carries double carbon lightning arresters on each subscriber's pair of wires, and forms an easy means of changing connections if the subscriber's number is for any reason changed. In this room also are fixed fuses on each wire to blow at two-thirds of an ampere, should any wire come in contact with a lighting or traction wire. The subscriber's end is protected in the same way. Before every new wire is connected up it must be tested, this being done by means of Lord Kelvin's reflecting galvanometer.

From the test room the wires are led under the floor to the switchboard in the hall below. For this purpose the wires are bunched into a flat strip about $1\frac{1}{4}$ in. $\times$ $\frac{3}{8}$ in. for convenience in wiring the building, paraffined cotton being here used as the insulation. In the switch room the wires come down the wall and under the floor to the switch table containing the plug holes.

The switchboard here differs from any other that has yet been made, in so far that the wires are brought along each side, under wood planking, the benefit being that every wire is visible on raising a plank of the floor, this forming a much better arrangement than the old system, where the wires were all bunched in the centre of the switchboard. The switchboard is at present being built to accommodate 10,000 subscribers, but space has been taken for 20,000, and the buildings are leased for 28 years. Every operator can control the 10,000 subscribers by simply stretching her arm either to the left or right. To accomplish this, every subscriber is multipled, and the switchboard is double sided, the operators being seated at each side. The interconnecting plugs are suitably coloured in pairs, and hang counter-poised above the table containing the sockets to which the subscribers' wires are fixed. These sockets are so arranged in rectangles that an operator can at a glance place the two numbers in communication with one another by plugging each socket with one of the plugs referred to.



Glasgow Tramways: Switchboard for Auxiliary Generators.

Each rectangle contains 100 socket holes or subscribers' ends, and the number of that 100—say, 12, if the subscriber's number was anything between 1,200 and 1,299, or 15 if it was between 1,500 and 1,599—is engraved in large white numerals on the black ebonite base, so as to embrace the 100 plug holes or sockets.

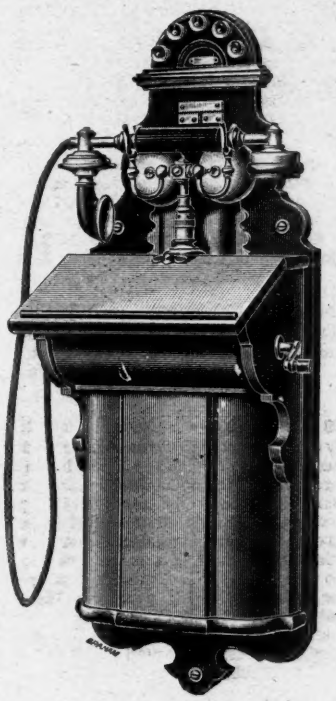
The system is most compact, and overhearing conversation is impossible.

When complete, every operator will control 40 subscribers, but this number can be reduced or increased at the will of the chief operator, who controls the call wire board situated in a corner of the switch room.

The bells are worked by means of a small magneto generator driven by motor off the electricity mains, the whole service being worked on the call system; the operators' keys are handy—about the height of the head.

Between the test room and switchboard some 310 miles of wire have already been used, and there are some 1,000 soldered joints.

None of the lead-covered cables exceed 3 in. diameter. The cables are kept dry by means of compressed air at about 20 lbs. per square inch pressure, and it is intended to fit



G.E.C. Wall-telephone.

pressure gauges to all the cables entering the exchange to indicate any leak or fall in pressure due to a puncture in the lead casing or other cause. The loose ends at the exchange end are sealed in the test room.

So far the service has given every satisfaction, but it must be remembered the service has been free since April last.

The authorities have still adhered to the idea that exchanges should be as near the sky as possible—why, we cannot tell. Perhaps the cheaper rent of a top storey accounts for it.

Have the authorities given any thought to the disorganisation a fire would cause in a building of this sort, some six storeys in height, where a public house occupies one of the shops on the ground floor?

The opening ceremony passed off very well. The Lord Provost, Bailie Alexander, and Mr. Bennett, the general manager, were each presented, on behalf of the contractors, with a chased silver flower bowl by Mr. Tidd, of Messrs. Morris, Warden & Co., their Glasgow representatives. The contractors were:—For cables, the British Insulated Wire Company; switchboard, the Telegraph Manufacturing Company; testing jack, the International Electric Company; subscribers' instruments, the Ericsson Bell Telephone Company and the General Electric Company (1901), Limited. The above illustration shows the type of instrument supplied by the General Electric Company.

For much of the foregoing information we have to thank Mr. A. R. Bennett, the general manager, and Mr. McFie, his assistant.

ELECTRIC LIGHT AND POWER NOTES.

(*Continued from page* 392.)

Paarl (S.A.).—Application has been sent in to the Town Council by certain parties, for permission to light the town with electricity and to run electric trams.

Shipley.—The D.C. last week started its electric lighting installation.

Sleaford.—The electric lighting of the streets has just been inaugurated.

Spennymoor.—The erection of the buildings for the Northern Counties Electricity Supply Company's electricity works has been commenced

Sunderland.—The E.L. Committee has determined to put the surplus of last half-year, total £1,257, to form a reserve fund. The Committee is going to ask the L.G.B. for sanction to borrow a further £30,000 for extensions of the two generating stations, and of the mains.

West Bromwich.—The T.C. has decided to charge for electricity for lighting on the maximum demand system at 4½d. and 1½d. per unit, and for power at 1d. per unit.

Wimbledon.—The adoption of the maximum demand system by the U.D.C. has resulted in an average reduction of cost per unit to consumers from 5·7d. to 4·9d. The position of the Council's undertaking on July 31st was as follows:—Private consumers, 8 c.p. lamps, 28,228; street lamps connected, 4,448; street lamps to be connected, 180; maximum load, 370 kw.

Windsor Castle.—It is stated that the electric generating plant is to be extended, to provide for lighting and power, charging motor cars, &c.

ELECTRIC TRACTION NOTES.

Birkdale (Southport).—The Electricity and Tramways Committee are pushing on with the electrical tramway construction in the district. The Committee recently resolved that the chairman and accountant should proceed to London to press for a settlement of all matters outstanding with respect to electric lighting and tramways.

Birkenhead.—The Tramways Committee have decided to double parts of their new electric car tracks, and are seeking power to borrow two sums of £2,423 and £6,570 to enable them to carry out the work.

A short stoppage was occasioned on the Argyle Street south route, on Friday night, by a trolley wheel falling from the arm, and being lost in the darkness in a field by the road-side.

Central London Railway.—There was a stoppage of the system for about three-quarters of an hour last Monday afternoon. The daily press has ascertained that attempts to stop smoke nuisance at the generating station necessitated a change of coals, Midlands being abandoned and Monmouth substituted, and the alteration had been made that morning. It is stated that the trouble was not altogether due to any inferiority of the fuel, but more to the fact that the coal had never been used in the furnaces before. To obtain the full heat efficiency from the new material was, however, merely a matter of education, and a similar mishap need never be expected to occur again. The company are about to increase their boiler plant at the works.

Cleckheaton.—The British Electric Traction Company are to construct and work a tramway through Cleckheaton, having a length of 2 miles, 600 yards, power being supplied by the District Council.

Doncaster.—The tramway scheme is making progress, the laying of the tramway having been commenced at Hexthorpe. The electrical works have cost £45,000, and the tramway scheme (trolley) will cost £75,000, without the plant. It is hoped that the first section will be opened in January. There will be about 7 miles of street track. Fifteen cars have been ordered from Messrs. Dick, Kerr & Co.; the tramway cables are being made by the Callender Company, Limited. The rails are coming from Belgium; they weigh 95 lbs. per yard, and are 60 ft. long. Most of the track is single, with loops. The whole system may be completed about the end of July next year. The Corporation have just decided to make a reduction in the charges for electricity, which is to be carried out on the Wright maximum demand system, charging the consumer at the rate of 5d. per unit for the first hour of maximum demand, 4½d. for the second, and 3d. for everything after, the charge for power being reduced from 3d. to 2d. on the uniform rate.

Wimbledon.—The scheme of the L.U.T. to construct electrical light railways from the termination of its authorised lines at Kingston, along Coombe Road, through Raynes Park, Worple Road, over Wimbledon railway bridge, and thence through Merton to the London County Council's boundary at Tooting, and also a section connecting New Malden to Sutton and Carshalton *vid*

Merton and Wimbledon, was discussed at the meeting of the Wimbledon U.D.C. on the 28th ult. The comprehensive scheme referred to is for 38 miles of line, of which only two miles affect Wimbledon. The discussion of the matter provoked a very lively debate, but ultimately a resolution was passed favouring the scheme.

Rural Surrey.—The details of the L.U.T. scheme for extensions to Epsom and district have been ascertained by a representative of the *Surrey Herald*, who was told by Mr. Clifton Robinson that his company were determined, in course of time, to extend their system of electric traction into the whole of Surrey, both Metropolitan and rural, and he exhibited a map which showed that the company have already prepared plans relating not only to Epsom and Leatherhead, but also to Ashtead, Ewell, Cheam, Sutton, Carshalton, Hackbridge, and Mitcham. Starting from Leatherhead, the proposed line passes along the main road to Ashtead and into Epsom High Street. Thence the line goes to Ewell, North Cheam, Morden and Merton. From Ewell there will be a branch through Sutton and Carshalton to Croydon, and another branch goes from Carshalton through Hackbridge, Beddington Corner and Mitcham to Singlegate, where it will join the proposed line from Kingston and Malden through Wimbledon. It is also proposed to extend the line at Surbiton through Tolworth to Ewell and Epsom. Although it would be possible to drive the whole of these suggested lines with current generated at the central station at Chiswick, it is probable, should the necessary powers be obtained, that a generating station will be established at some convenient spot in Surrey. The leading residents of Epsom have expressed themselves very strongly against the introduction of any tramways into their district.

France.—La Compagnie des Tramways Mécaniques des Environs de Paris has just completed and opened for traffic a new electric tramway between Pierrefitte, Asnières, Courbevoie, Puteaux, Suresnes and St. Cloud. The line, which is about 20 kilometres long, is on the overhead conductor system.

Great Northern and City Railway.—In our "Notes" last week describing the Great Northern and City Railway the length of the journey was given as seven miles. This is the length of the round trip, the length of the single journey being three and a half miles.

Isle of Man.—Though lower fares have been in operation on the Isle of Man Tramways during the present season, the receipts are said to have exceeded those of last year by £3,000.

Leyton.—The U.D.C. is considering whether to buy up the Leytonstone section of the North Metropolitan Tramway Company's system.

Plymouth.—An accident of a somewhat unusual character occurred here last week. The high wind blew down a tree which fell across the trolley wires. The service was thrown out for half an hour.

South Staffordshire.—On Saturday last the ceremony of inaugurating extensions of the British Electric Traction Company's system in South Staffordshire, took place at Kinver, near Stourbridge. Mr. Garcke stated that nearly a million and a half had been spent upon the lines in the district. Twenty-four local authorities had to be dealt with, and of these only three or four were holding out against them, Wolverhampton being the chief.

Liverpool.—The controversy over the management of the Liverpool electric tramways has broadened, and has become, for the time, the subject of prime importance in the city. This has been partly brought about by the peremptory dismissal of Mr. P. McCullough, manager at the Lambeth Road car manufactory of the Liverpool Corporation, under suspicion of having given information of the working of the tramways to Councillor Thomas Utley, who first criticised the Committee's management in the columns of the local press. Mr. McCullough has denied, both to the deputy-chairman of the Tramways Committee, and through the Press, that he gave such information to Mr. Utley, and Mr. Utley has also stated that Mr. McCullough did not give him any of the information on the points on which his own charges against the Tramways Committee were based. Local interest in the subject was intensified by the dismissal of Mr. McCullough, and an animated correspondence is taking place in the columns of Liverpool papers. Mr. McCullough has issued a full statement of his case to the Press. In the statement, he speaks of having had to report unfavourably on work done and materials supplied for the department, and of being questioned by a member of the Tramways Committee as to why he had done this. He further states that he had constantly reported since August of last year, that the wheels being supplied were unsatisfactory; the record for 1900 being only 10,000 miles, and for the first seven months of this year, the life being about 7,000, whereas he had pointed out the necessity of purchasing wheels under a guarantee as other cities did, of 25,000 miles, for less money than the price the Committee were paying. Notwithstanding his report, further contracts had been entered into with the same firm for further supplies without receiving quotations or obtaining any guarantees of mileage. Speaking of brake blocks, Mr. McCullough states that on taking up his duties in July last, he found the life of brake blocks was three to four weeks. He accordingly had drawings made of a type of block he had used in Toronto, which had a life of 20 weeks, and suggested that a trial order should be placed with a Toronto firm and also with the Miller Company, of Edinburgh, who were supplying wheels for the Liverpool cars, in order to make a comparison before adopting a standard shoe for Liverpool. The result had been that the Canadian shoe lasted 12 to 14 weeks against three or four weeks of the old shoe.

One of the chief critics of the Committee has written a further exhaustive letter on the construction and working of the electric car system. He states that he did not seek to cast the slightest reflection on the contractors for the overhead work (Messrs. R. W. Blackwell & Co.), knowing that this must have been executed to the requirements of, and in accordance with, the specifications prepared by the city engineer, and approved by the Tramways Committee, where responsibility must lie. This critic, however, maintains that the span wires fixed to the walls by rosettes have been, and are now, being removed by the dozen, and that the trolley wire used in Liverpool will not stand a strain exceeding 3 tons, whereas the Sheffield Corporation and the Dublin Tramways Company use wire with at least twice this breaking strain; also, that the wire is stretching, and that in some parts it has had to be tightened. Councillor Utley has written speaking in high terms of Mr. McCullough, and stating that the ratepayers will be wise in not allowing a man of his ability and experience to be summarily dismissed in the manner in which he has been.

At Wednesday meeting of the Council, Mr. Higginbottom, M.P., moved that the sum of £300,000, authorised by the L.G.B. to be borrowed for electricity purposes, be placed at the committee's disposal. Mr. Utley moved an amendment that the recommendation be postponed until a statement showing the receipts and expenditure for the past six months had been submitted. After some discussion, 20 voted for the amendment, and 57 against it.

Llandudno.—The expenses incurred in connection with the proposed Colwyn Bay and Llandudno electric tramway scheme have, it is said, already swallowed up nearly £17,000, and the work of construction has not yet begun. The light railway company have submitted their final agreement to the D.C., and it has been referred to a joint committee of the Electric Lighting and Gas Committees.

Manchester.—A collision took place in Rochdale Road, Manchester, on Saturday morning, between one of the new electric cars and a locomotive which was crossing the road into the Corporation gasworks. The driver of the electric car narrowly escaped with his life.

Melbourne (Victoria).—A Committee of the Legislative Council recently reported to that body on electric traction on railways. The report stated that inquiries led to the conclusion that electricity as a motive power for railways was quite equal to steam, and that it appeared to be merely a question of time as to its superseding steam altogether. It was recommended that a trial be made on the St. Kilda line, the cost of supplying an installation to which would be £43,000. It was estimated that if this line was run by electricity, with double the present service and more stopping places, a saving of £8,000 a year could be effected. It was also recommended that the Collingwood line be worked by electricity. Unless this were done it would not be able to compete successfully against the trams, owing to the unpleasantness that would be caused by smoke when passing through the tunnels on the line.

Nelson.—From the new generating station which the Corporation is now erecting, a tramcar service from Brierfield through Nelson to Colne, and a light railway from Nelson to Barrowford, are to be supplied with power.

Nottingham.—The annual report of the Tramways Committee, which came before Monday's Council meeting, shows the progress that has been made with the conversion of the tram system to electric traction, and the state of the different sections now constructing. The report of the tramways manager (Mr. J. Aldsworth) states that very few accidents occurred during the year, none being of a serious nature, which considering the change in the system of traction on the Sherwood route, and that the electric cars are being worked almost entirely by men previously engaged on the horse cars, speaks well for the careful way in which the staff generally have performed their duties and carried out the rules and regulations made for the safe working of the undertaking. The statement of accounts relating to the electric trams shows liabilities amounting to £180,358 18s. 9d. The accounts for the first three months of the year show traffic receipts amounting to £4,753 12s. 4d., and advertisements on cars £57. The expenditure amounted to £2,288 5s. 9d., and included £650 17s. 9d. for electrical energy (power and lighting); £1,074 7s. traffic expenses; £156 7s. 10d. maintenance and renewals, and £301 8s. 1d. for arc lamps on route of tramway. The net revenue account shows:—To proportion of expenses of issue of 3 per cent. redeemable stock, £359 7s. 7d.; interest on consolidated stock, £4,846 3s. By balance brought from revenue account, £2,522 6s. 7d.; balance carried to balance-sheet, £2,683 4s. The Tramways Committee also presented a report as to obtaining additional powers for the extension of the electric tramways. They recommended the Council to obtain Parliamentary powers to enable the Committee to reconstruct the Forest Road line, and to construct six additional lines connecting those for which the necessary powers have already been obtained.

Stalybridge and District.—The joint board of the Stalybridge, Dukinfield, Mossley and Hyde authorities is about to make an immediate commencement with 30 miles of single line through those districts.

Sunderland and Houghton.—All the technical arrangements for the Sunderland District and Houghton-le-Spring Tramways Company have now been completed, and arrangements have been made for the local authorities to apply for powers to extend the line through the Washington district. Messrs. Dick, Kerr and Co. have obtained the contract for the first part, and the consulting engineers are Messrs. Handcock & Dykes, in collaboration with Messrs. D. Balfour & Son, both of London and Newcastle.

West Riding.—The first board meeting of the West Riding Tramways and Electricity Supply Company, which will supply electric lighting and power for an area of about 40 square miles, and work a system of tramways about 12 miles in length, was held on Thursday last week. Among other business transacted, Messrs. Handcock & Dykes were appointed consulting electrical and mechanical engineers, with Messrs. Le Maitre & Parker to collaborate with them locally for the construction of the track and road improvements. Major Tulloch, C.B., R.E., late of the Local Government Board, was also appointed general advisory engineer.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899 ..	..
Para-Maranham	March 1, 1900 ..	..
Basseterre-Les Saintes	June 29, 1901 ..	..
Nase-Keelung (Formosa)	Aug. 2, 1901 ..	Aug. 28, 1901
Cadiz-Teneriffe	Aug. 6, 1901 ..	..
Bissao-Bolama	Aug. 16, 1901 ..	..
Trinidad-Demerara	Aug. 26, 1901 ..	..
Landlines :—		
"*Via* Hanekin" on Persian territory ..	Feb. 24, 1900 ..	..
Pekin-Kalgan	June 14, 1900 ..	..
Maimatchin-Kalgan	June 30, 1900 ..	..
Communication with Baranquilla and Cartagena	Dec. 8, 1900 ..	..
" towns of Venezuela ..	Oct. 31, 1900 ..	..
Moulmein-Bangkok	Aug. 30, 1901 ..	Sept. 2, 1901

Telephones in Fortresses.—The *Daily Telegraph* says that the military authorities have under consideration the provision and training of a proportion of non-commissioned officers and men as telephone operators, for duty in fortresses and defended ports on a mobilisation for home defence.

TELEGRAPH AND TELEPHONE NOTES.

Accrington Telephones.—The T.C. is to inquire *re* telephony with a view to its adoption for the Accrington and Blackburn district.

Barnsley Telephones.—The borough electrical engineer is to report on municipal telephones.

Cape Colony Telegraph Imports.—According to the Official Statistical Register of the trade of Cape Colony the value of the telegraph material imported last year into the Colony from the United Kingdom was £13,155.

Halifax Telephones.—The Chamber of Commerce circularised the 954 subscribers to the National Telephone Company in the Halifax area asking their views as to municipal telephones. 324 replies were received; 160 approve the suggestion, 98 on conditions, and 55 disapprove. A motion came before the Chamber last week urging the Corporation to obtain telephone powers, but this was negatived by 11 votes to 3.

Manchester Telephones.—The Special Committee on Municipal Telephones, in its report to the Manchester City Council, states that the draft scheme for the formation of a joint board prepared by the Town Clerk of Salford is practicable. The scheme will be discussed at a conference to be held early in September.

Melbourne Telephone Service.—We read in the *Melbourne Age* of July 31st, that the committee of electrical experts appointed to consider the question of "standardising" the telephone and telegraph systems of the Commonwealth has practically finished its work. The committee, after inspecting the systems in operation in Queensland, New South Wales and Victoria, has for the past three or four weeks been holding sittings in Adelaide. A report, embodying the conclusions of the committee, has been drawn up. In regard to the telephone system, the committee has practically condemned the instrument at present in use in Melbourne, and has recommended for general use throughout the States the telephone in use in Sydney. The instruments used in Queensland and South Australia have been approved of, although not regarded as so perfect as the other. The committee has also agreed on the urgent necessity of reforming the Melbourne telephone system by placing the wires underground. The report will shortly be in the hands of the Postmaster-General.

Postal Telegraph Employés.—The first official event of the Trades Union Congress was a mass meeting of Postal and Telegraph employés. The chair was taken by Mr. Brynmor Jones, M.P., who was supported by Sir George Newnes, Bart., M.P., Mr. R. Bell, M.P., Mr. H. Atherley Jones, M.P., Mr. Ben Pickard, M.P., Mr. W. C. Steadman, L.C.C., and Messrs. Edmond Browne, K.C., W. E Clery, W. B. Cheeseman, C. H. Garland, and many others. The meeting was an exceptionally large and crowded one, and took place at the Hotel Metropole, Swansea. The chairman, in his opening remarks, drew attention to the vast development of the Post Office during the last century. It was an organisation of a highly centralised character, and in order to ensure efficient working it was absolutely necessary that each unit of the system should be contented. Mr. C. H. Garland moved a resolution asking for the appointment of a Parliamentary Committee to investigate the present unsatisfactory state of the service. They wanted, in effect, a Board of Arbitration of the nature of those the present Government had sought to encourage by the passage of the Conciliation Act of 1896. Mr. Gardiner, of the Postmen's Federation, seconded, and the resolution was supported by all the M.P.'s present. Miss Gertrude Tuckwell delivered a spirited address to the ladies, in which she persuaded them to assist the men in their struggle. A further resolution in favour of the recognition of the service organisations, and the granting of full civil rights to Post Office servants, was proposed by Mr. C. E. Hall, and passed. The postal employés occupy a very prominent place among the Congress delegates this year, and have a voting power of 35,000, but their especial business will not be reached until the end of the week.

CONTRACTS OPEN AND CLOSED.

OPEN.

Ashton-under-Lyne.—September 18th. The Corporation wants tenders for surface condenser with pump. See "Official Notices" to-day.

Batley.—September 14th. The Corporation is advertising for tenders for all materials for the permanent way of 3½ miles of electric tramway in the borough.

Blackpool.—Tenders for 30 arc lamps, switches, &c., for rectified current, for the Corporation. See "Official Notices" to-day.

Bournemouth.—September 16th. The Town Council wants tenders for tramway rails, permanent way construction and rail bonding, and paving. See "Official Notices" August 23rd.

Bournemouth.—September 17th. The Town Council wants tenders for steel rails, permanent way construction on the conduit system, ploughs, &c., and paving. See "Official Notices" August 30th.

Doncaster.—September 14th. The Corporation invites tenders for tramway poles and overhead construction. See "Official Notices" August 30th.

Dundee.—September 14th. The T.C. invites tenders for overhead equipment for new tramway routes. See "Official Notices" August 23rd.

Edinburgh.—September 9th. For the electric lighting installation for the second portion of the Colinton Mains Fever Hospital (800 points), for the Corporation. See "Official Notices" August 9th.

Egypt.—September 15th. According to the *Board of Trade Journal* the Local Committee at Fayoum have decided to instal the electric light in the town. Persons wishing to tender can obtain the conditions of contract from the Minister of Public Works at Cairo.

France.—October 1st. The French Post and Telegraph Authorities in Paris are inviting tenders for the supply of a multiple telephone table for the telephone exchange at Lille. Particulars may be obtained from, and particulars are to be sent to, Le Sous-Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris.

Hammersmith.—September 13th. The B.C. wants tenders for pipework and tanks for the electricity works. See "Official Notices" to-day.

Italy.—September 9th. The authorities of the Adriatic Railway in Florence want tenders for the supply of a 4-ton electric crane for the railway station at Florence. Tenders to L'Administration des Chemins de Fer de l'Adriatique (Meridionaux) Florence, whence particulars may be obtained.

Kingston-upon-Hull.—September 26th. The Corporation wants tenders for two high speed three-crank 800-I.H.P. compound engines and four Lancashire boilers. See "Official Notices" August 30th.

Kirkcaldy.—September 13th. The Corporation wants tenders for the supply and erection of overhead construction for electric tramways. See "Official Notices" August 23rd.

Kirkcaldy.—September 16th. The Corporation wants tenders for the supply and erection of arc lamp-posts, brackets, and switch-boxes. See "Official Notices" August 30th.

Lowestoft.—September 9th. 500-KW. steam dynamo, switchboard panel, &c., for the municipal electricity works. See "Official Notices" August 16th.

Maidenhead.—September 23rd. Three 60-KW. steam dynamos, two Lancashire boilers, economiser, &c., for the Corporation electric lighting. See "Official Notices" to-day.

trial order should be placed with a Toronto firm and also with the

through those districts.

Manchester.—September 14th. The Tramways Committee wants tenders for trolley wire and overhead line materials. See "Official Notices" August 30th.

Newport.—October 21st. Coal-handling winches, cables, overhead construction, electric motor car, and repair shop equipment for the Corporation tramways and power works. See "Official Notices" to-day.

Oldham.—September 10th. Two electric travelling cranes for the Greenhill electricity works. See "Official Notices" August 16th.

Poplar.—September 18th. The Borough Council wants tenders for multiple core lead-covered cables and accessories. See "Official Notices" August 30th.

Russia.—September 14th. The municipal authorities of Erivan (Caucasia), are inviting tenders until September 14th, for the construction of an electric tramway, about four kilometres long, in the town. Tenders are to be sent to the municipal authorities of Erivan, whence particulars may be obtained.

Salford. — September 14th. The Health Committee wants tenders for a 55-kw. steam dynamo. See "Official Notices" August 30th.

Salford.—September 20th. Lighting the new generating station for the Corporation See "Official Notices" to-day.

Sheffield.—September 30th. Boilers, motors, fans, iron chimneys, &c., for the electricity department. See "Official Notices" to-day.

Southend-on-Sea.—September 7th. The Corporation wants tenders for supplying and laying electric lighting cables. See "Official Notices" August 23rd.

Torquay.—September 13th. The E.L. Committee invites tenders for the supply of arc lamp carbons for a period of 12 months from October 1st, 1901. See "Official Notices" August 23rd.

Whitehaven.—September 16th. The Corporation wants tenders for the supply of incandescent lamps for six months. See "Official Notices" August 30th.

Willesden.—Economisers, boilers, piping and pumps, steam dynamos, battery, wiring, &c., for electricity works for the Willesden Infirmary. See "Official Notices" to-day.

CLOSED.

Dundee.—Messrs. J. M'Adam & Sons, of Aberdeen, have secured the contract for laying the second portion of the Fairmuir tramway route at a cost of £12,104.

Eastbourne.—On Monday the T.C. accepted the tender of Messrs. J. & A. Law for the supply and erection of 67 arc lamp-posts at £1,084; also that of the Gilbert Arc Lamp Company for double carbon lamps, burning 40 hours, and apparatus for lowering and raising the lamps, at £1,147.

Manchester.—The fact that the Electricity Committee of the Corporation has recommended that body to accept the tender of a German electrical company, has caused much perturbation in local circles. Dr. Bishop, Chairman of the Committee, gives amongst other reasons that the German Company took up all the specifications and that they were absolutely the lowest by £1,000 to £2,000. Dr. Kennedy, the Corporation expert, also recommended that the order should go to a firm that could take up the whole of the specifications.

South Lancashire.—The South Lancashire Electric Traction and Power Company have accepted the tender of Messrs. A. Krauss & Sons, Bristol, for the construction of about 30 miles of track.

Tyneside.—Messrs. Crompton & Co. have received the contract at £6,000 odd for electric lighting plant and mains for certain docks of the Tyne Improvement Commissioners.

Wrexham.—The D.C. has accepted the tender of the Sloan Electrical Company, London, for supplying carbons at £7 per 1,000 pairs.

FORTHCOMING EVENTS.

Wednesday, September 11th to 18th.—Glasgow. Annual Congress of the British Association for the Advancement of Science.

NOTES.

Personal.—Happily events which occurred about the year 1893 enlightened the public to some extent as to the real value of the all-healing appliances of the electro-medical quack. It was, however, an unfortunate result of the public enlightenment that the legitimate practice of electro-therapeutics on right lines should, for a time, at any rate, be brought under a clond of disfavour and even suspicion. The details of the matter are doubtless well within the remembrance of thousands of readers of the Electrical Review. Among electro-medical men who suffered as a consequence of the imposition practised by others was Mr. H. Newman Lawrence, who subsequently crossed the Atlantic to try his fortunes in the West. It will interest many of that gentleman's friends to hear that he is still very comfortably placed in the United States, and to note his doings. He is not connected with the electro-medical profession, but from a letter recently received from him, we learn that, as the Rev. H. Newman Lawrence, he for some five years had charge of two mission churches on Staten Island. On the recommendation of the Bishop of New York, he has now been appointed rector of a small parish in one of the prettiest and most fruitful countries of New York State, just 100 miles out from New York City. Here under very happy circumstances he celebrates his silver wedding during the present month. As Mr. Lawrence scans his Electrical Review, and goes in and out among his pastoral flock, he thinks over again with considerable gratitude of his old friends on this side of the water.

Mr. Henry Joseph, lately with Messrs. Thomas Parker, Limited, has been appointed assistant engineer to the Harrow Electric Light and Power Company, Limited.

Mr. W. M. Brigg and Mr. J. B. Atherton have resigned their positions as directors of the British Insulated Wire Company, Limited. Mr. Atherton, at the unanimous request of the board, has agreed to remain the general manager of the company.

The Pacific Cable Board has appointed Mr. Charles Henry Reynolds, C.I.E., late Director-General of Telegraphs in India, as its general manager.

Mr. Fred Bathurst, who has recently returned from an extended holiday in the U.S.A., asks us to state that he is severing his connection with the Conduit and Insulation Company, Limited. For the present communications will find Mr. Bathurst at 6, Loudoun Road, St. John's Wood, N.W. As soon as his future plans are matured, we may expect to find him during the approaching season actively pushing further developments in the electrical business.

Mr. Stephen E. Bastow was recently presented with a handsome solid silver tea service by the staff of the Barnsley Corporation electricity works, on the occasion of his marriage. Mr. E. A. Barker, chief assistant, made the presentation.

Mr. Edward Tracey has resigned his appointment as secretary of the British Insulated Wire Company, a post which he has held for the past 8 years. Mr. Tracey is shortly to sail for Australia.

We regret to learn that Mr. R. C. Quin, of Blackpool, has broken down in health. He has been granted a month's holiday. He asked to be released from his engagement with the Corporation at the end of the month, but the Committee is anxious to retain his services until the lighting and tramway extensions have been carried through. These are expected to take until March, 1903.

Mr. W. Wild, of Wednesbury, has been appointed Corporation electrical engineer at Doncaster, in place of Mr. Prussman, who goes to Swansea.

The Royal Observatory and Electric Disturbances.—The Astronomer Royal, in his report on the Greenwich Observatory, which has just been published as a Parliamentary paper, states (says the *Globe*) that the question of the possible effect of disturbances from electric railways on the magnetic work carried on at the Royal Observatory has required very careful consideration in regard to the conditions under which electric traction may be used without injuriously affecting the magnetic records. The London County Council propose to adopt for their electrical tram-

especial business will not be reached until the end of the week.

dynamos, two Lancashire boilers, economiser, &c., for the Corporation electric lighting. See "Official Notices" to-day.

ways in the neighbourhood of the Observatory a satisfactory system of well insulated returns, and there is reason to hope that their example will be followed in the case of another tramway in the neighbourhood, belonging to the South-Eastern Metropolitan Tramways Company, these two tramways being those which would most seriously threaten the magnetic work. In the case of other tramways for which electric traction is proposed, it is hoped that regulations will be laid down by the Board of Trade to secure adequate protection for the magnetic work at Greenwich, which has now been carried on continuously on the same general system for a period of 60 years, and which could not be transferred to another site. It may be remarked that the French Magnetic Observatory at St. Maur is in much the same position as Greenwich in respect to electric tramways, and recently M. Moureaux, in charge of that Observatory, has found that copper "dampers" (such as have been in use at Greenwich for 60 years, but had not previously been applied to the magnets at St. Maur) reduce the vibratory disturbances from electric tramways to about one-tenth of their amount. This was recently verified at Greenwich by the converse process of removing the copper "dampers" which are in regular use with the declination and horizontal force magnets, when it was found that the disturbances from existing electric railways were increased to about 10 times their usual amount. It is proposed to apply a "damper" to the vertical force magnet, the need for which has not hitherto been felt, and it is possible that the "dampers" for the other two magnets may be improved by the use of copper of much higher conductivity than was obtainable when they were made 60 years ago.

The Water-tube Boiler Explosions at Sardinia Street.—The report of a Board of Trade investigation into two explosions of boilers at the works of the Metropolitan Electric Supply Company, Limited, Sardinia Street, Lincoln's Inn Fields, has been issued, and is abstracted in the *Times*. The first explosion occurred on November 17th, 1900, and a fireman received such serious injuries that he died from their effect next day. The boiler was of the water-tube type, 18 ft. 6 in. long, 8 ft. 6 in. wide, and 14 ft. high, and was made by Messrs. Babcock & Wilcox, Limited, of London and Glasgow, in 1889. It was 11 years old, had been repaired at various dates, and had been examined periodically. Mr. Howard Smith and Mr. J. H. Hallett, the Commissioners, find that the explosion was caused by a tube having become so weakened by overheating as to be unable to resist the steam pressure, and this overheating was caused by an accumulation of deposit in the tube, which prevented the proper circulation of water through the tube; that the iron used in the construction of the tube was of good quality, and that it was properly welded. They also think that the boiler ought to have been cleaned out at more frequent intervals, and that it was not periodically tested by hydraulic pressure for the purpose of examination. Such test as it was subjected to after repairs had been executed was not sufficient. Proper and sufficient measures were not taken to ensure that the boiler was being worked under safe conditions, inasmuch as proper and sufficient care was not taken to see that it was provided with suitable feed water, which in this case was supplied by the New River Water Company, and properly cleaned, having regard to the feed water that was used. The Commissioners have also formed the opinion that this type of boiler cannot be safely used unless great care is taken that the water should be as free as possible from solid matter. They are of opinion that the New River Company's water is quite unfit to be used in its natural state. The water, if better could not have been found, should have been treated by filtration and otherwise so as to free it from solid matter before it was introduced into the boiler. In one sense, there was neglect on the part of Mr. Reginald R. Todd, the chief engineer, and Mr. William E. Spencer, superintendent engineer, probably greater on the part of the former as being the head, inasmuch as there was an act of omission on their part in not taking steps to purify the feed water before it was introduced into the boiler. But the Commissioners do not think that the explosion was caused by blamable negligence on their part. The explosion was not caused, therefore, in the sense they had indicated by the neglect of Mr. Todd or of Mr. Spencer, and it follows, therefore, that no responsibility attached to the Electric Supply Company. The second explosion occurred on January 8th, 1901, and a fireman died owing to his injuries. The boiler in this case also was made by Messrs. Babcock & Wilcox, in 1890. It was ten years old, and had been repaired at different times. The Commissioners find that the explosion was caused by the tube having become overheated, and thereby so reduced in strength as to be unable to resist the working pressure of 150 lbs. per sq. in. This overheating resulted from an accumulation of sedimentary deposit in the tube, which impaired the circulation of water through it, and the boilers were not cleaned sufficiently frequently. Mr. Todd and Mr. Spencer are exonerated from blame also in this case, and the company are not held responsible for the explosion.

The Engineering Congress.—On Monday night Dr. Caird, LL.D., presided over the banquet to which the executive committee entertained 300 guests, to inaugurate the proceedings of the International Congress. The loyal toasts having been honoured, the Earl of Glasgow proposed "Foreign Governments," and Mons. B. Fontaine, M. J. Troost and Commendatore Breen replied for France, Belgium, and Italy, respectively. From an electrical point of view, the speech of Commendatore Breen was of interest. He said that Italy, from an industrial point of view, had laboured, and still laboured, under the great disadvantage of an almost complete absence of coal, but the use of steam was being rapidly superseded. The people had discovered that in their streams, rivers and lakes, they had an immense motive power sufficient to enable them to be almost entirely independent of coal. The potential quantity of the electric power was variously estimated at from 2,500,000 to 5,000,000 H.P., which would be equivalent to an annual consumption of from £25,000,000 to £50,000,000 sterling worth of coal. In all large towns electricity was being used for lighting, motor, and traction purposes. It was, therefore, hardly rash to prophesy that before many years the Italian railways and industries would be almost exclusively worked by electric power.

The Lord Provost proposed "Engineering Societies." To his mind engineering had a general, an educational, and a social aspect which was not to be overlooked.

Herr O. Von Muller replied for Germany; Herr A. J. Brucker Andreae for Holland; Colonel Huber for Switzerland; Prof. H. Carhart for the United States; and Mr. M. T. Eyde, Christiania, for Norway.

Prof. De Timonoff gave the toast of "The International Engineering Congress." Mr. Mansergh responded. He said that the whole idea of the Congress and the organisation rested with Scotland.

Mr. W. Foulis, president of the Institution of Engineers and Shipbuilders in Scotland, also replied.

Motor Vehicle Trials.—The automobile trials promoted by the Automobile Club commenced at Glasgow on Monday. The route was to Edinburgh and back, a triangular course being taken, making the distance 116½ miles. About one-third of the cars entered for the run were of French manufacture, and there were only two of American manufacture, the latter being steam vehicles. Edinburgh was reached after a run of 2 hours 28 minutes. Forty-one cars started out from Glasgow, and the first to return to the Exhibition was a 16-H.P. Panhard. A 9-H.P. Napier, however, reached the Glasgow milestone before it.

The Tramways and Light Railways Association Dinner.—The members of the above Association visited Glasgow on Wednesday, and the official programme was opened by a luncheon provided by the Corporation, under the presidency of the Lord Provost. Among the speakers were Sir C. Rivers Wilson, Mr. J. S. Raworth, and Bailies Anderson and Paton. The members dined at the Windsor Hotel in the evening, Sir C. Rivers Wilson presiding, and the speakers included Bailie Paton, Mr. Philip Dawson, Mr. John Young, and Mr. E. Garcke.

The Lindsay Memorial.—The memorial of James B. Lindsay, of wireless telegraphy fame, is to be unveiled at Dundee on Saturday, September 14th.

of the British Association for the Advancement of Science.

injuriously affecting the magnetic records. The London County Council propose to adopt for their electrical tram-

The Röntgen Society of the United States.—The annual gathering of this Society opens at Buffalo on Monday next, September 10th, and continues on the following day. The presidential address is to be delivered by Dr. Heber Robarts, of St. Louis, and a good number of papers are down for reading. One of these deals with "X Ray Work in Great Britain" (results of a trip), by Dr. Girdwood, of Montreal. Others are devoted to such subjects as diagnostic value of Röntgen rays, a one-minute localiser, electro-therapy for curing lupus, recent inventions in tubes, coils, &c., X ray problems, how the induction static machine can be excited without a separate charger, the discovery of the bacilli in cancer, mistakes in radiography, new electrolytic interrupter, light rays in tuberculosis, new development in Crookes's tube, X rays for cancer treatment, &c. Altogether, judging from the variety of subjects included in the programme, a very profitable gathering is promised.

Stockport Trams.—One of the new electric cars, when coming down a steep hill, left the rails and ran into a house. The car was not overturned, but the passengers were severely shaken.

Who is Helom?—The *Times* has been giving an excellent report of the proceedings at the Engineering Congress this week. One curious error has crept in—doubtless due to the printer—it being stated that Prof. Magnus Maclean read a paper on "*Helom's* Electric Measuring Instruments."

Appointments Vacant.—A superintendent of mains, at £250 per annum, is wanted by the Edinburgh Corporation. Cable jointers are required for Wolverhampton and West Bromwich, and an assistant engineer for Burnley. A shift engineer is wanted for Dundee.

Leeds and Municipal Telephones.—On Wednesday the Leeds Corporation voted 21 for and 21 against the appointment of a committee to visit other towns to investigate the subject of municipal telephones. The Lord Mayor did not exercise his casting vote, so the matter stands "as you were."

Obituary.—Mr. Clement Sneyd Colvin, a director of the Eastern and Eastern Extension and Submarine Trust Cable Companies, died suddenly from a stroke of apoplexy on Monday night last week at Lisbon.

NEW COMPANIES REGISTERED.

Lancashire United Electric Tramways, Limited (71,169).—This company was registered on August 20th, with a capital of £100 in £1 shares, to construct, maintain and work any tramways, light railways, electrical and other railways and motors therefor, and to carry on the business of builders of vehicles of all kinds, propelled or drawn by mechanical, animal or other traction, producers and suppliers of electricity for the purposes of light, heat or power, india-rubber manufacturers, makers of, and dealers in, tires for cycles and other vehicles, &c. The first subscribers (each with one share) are:—A. T. Pendry, 3, Manor Place, Hackney, registrar; J. Gladwin, 40, Holborn Viaduct, E.C., housekeeper; E. C. Parford, 40, Holborn Viaduct, E.C., secretary; D. J. Norris, 61, Linden Street, Fitzroy Square, W., clerk; W. H. Kohler, 40, Holborn Viaduct, E.C., secretary; R. W. Smith, 40, Ellerdale Street, S.E., clerk; and G. C. A. Kohler, 74, Wool Exchange, E.C., merchant. No initial public issue. Registered without articles of association.

Lancashire and Yorkshire Electric Tramways, Limited (71,168).—This company was registered on August 20th, with a capital of £100 in £1 shares, to construct, maintain and work any tramways, light railways, electrical and other railways and motors therefor, and to carry on the business of builders of vehicles of all kinds, propelled or drawn by mechanical, animal, or other traction, producers and suppliers of electricity for the purposes of light, heat or power, india-rubber manufacturers, makers of and dealers in tires for cycles and other vehicles, &c. The first subscribers (each with one share) are:—A. T. Pendry, 3, Manor Place, Hackney, registrar; J. Gladwin, 40, Holborn Viaduct, E.C., housekeeper; E. C. Barford, 40, Holborn Viaduct, E C., secretary; D. J. Norris, 61, Linden Street, Fitzroy Square, W., clerk; A. W. Hoale, 3, Cemmac Terrace, Cotteralls Hill, Hemel Hempstead, accountant; J. H. Moore, Jubilee Villas, Ware Road, Hertford, retired innkeeper; and G. C. A. Kohler, 74, Wool Exchange, E.C., merchant. No initial public issue. Registered without articles of association.

Buenos Ayres Electric Tramways (1901), Limited (71,206).—This company was registered on August 24th, with a capital of £250,000 in £5 shares, to adopt an agreement made by this company with the South American Syndicate, Limited, to construct in the Argentine Republic or elsewhere in South America, railways, tramways, light railways, cars, omnibuses, engines, rolling stock, electrical and other plant, machinery, rails, sleepers, stores and all other requisites, materials and equipment therefore, and to carry on the business of carriers of goods, and passengers, van and omnibus proprietors, producers and suppliers of electricity for the purposes of light, heat or power, electricians, mechanical engineers, millwrights, sawyers, grinders, workers and dealers in mineral, oils, timber, wood and its products. The first subscribers (each with one share) are:—H. E. Warner, 10, Finsbury Circus, E.C., solicitor; A. Constable, 144, Victoria Street, S.W. gentleman; G. F. Swainson, 10, Finsbury Circus, E.C., solicitor; A. Balderson, 27, Crofton Park Road, Brockley, cashier; O. E. Radmore, 17, Coleman Street, accountant's clerk; W. H. Ockenden, 17, Coleman Street, E.C., cashier; and W. A. Hunter, 8, Coleman Street, E.C., gentleman. No initial public issue. The number of directors is not to be less than four nor more than seven; the first are to be appointed by the subscribers; qualification, £500; remuneration, £250 each per annum, £400 for the chairman. Registered office, 17, Coleman Street, E.C.

Wrexham and District Electric Tramways, Limited (71,213).—This company was registered on August 26th, with a capital of £50,000 in £5 shares, to carry on in the United Kingdom or elsewhere the business of carriers of passengers and goods, electrical engineers and contractors, manufacturers of and dealers in rail, tramway, and electrical apparatus, mechanical and chemical engineers, producers of gas, electricity, &c., for the purposes of light, heat, or power, and any other business which can be conveniently carried on in connection with the same. The first subscribers (each with one share) are:—B. Kingsford, 77, Queen's Road, Wimbledon, gentleman; S. Humphry, Foxton House, Royston, Cambridgeshire, gentleman; W. F. Herring, Donington House, Norfolk Street, W.C., gentleman; W. F. Cox, 60, Chancery Lane, W.C., solicitor; S. N. Wells, 39, Ivydale Road, Nunhead, gentleman; G. E. Medhurst, 208, Dulwich Rise, S.E., secretary; and W. S. Wreatball, Donington House, Norfolk Street, Strand, W.C., secretary. No initial public issue. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first directors; qualification, one share; remuneration, £50 each per annum, with an increase according to profits. Registered office, Donington House, Norfolk Street, W.C.

Electric and Ordnance Accessories Company, Limited (71,240).—This company was registered on August 29th, with a capital of £50,000 in £1 shares, to carry on the business of manufacturers of and dealers in omnibuses, motor cars, and other vehicles, electricians, engineers, machinists, ironmasters, manufacturers of railway and other plant, gun, gun carriage, and ordnance manufacturers, makers of arms and ammunition of all kinds, &c. The first subscribers (each with one share) are:—P. Thaine, 32, Victoria Street, S.W., secretary; J. T. Coffin, 57, Drakefield Road, Upper Tooting, S.W., managing clerk; J. G. Shields, 120, Bensham Manor Road, Thornton Heath, clerk; H. J. Morriss, 32, Victoria Street, S.W., engineer; T. G. Osborn, 28, Victoria Street, S.W., clerk; H. E. Rich, 116, Clapham Park Road, S.W., accountant; and J. G. Robinson, 18, Cecil Road, Harlesden, N.W., accountant. Minimum cash subscription one-half the shares first offered to the public. The number of directors is not to be less than three nor more than five; the first are to be appointed by the subscribers; remuneration as fixed by the company.

Astar Company, Limited (71,214).—This company was registered on August 27th, with a capital of £2,000 in £1 shares, to acquire as a going concern the businesses of the German American Electric Company, and of Kroning & Co., now carried on by P. Stern and E. F. H. Kroning, at 11 and 13, St. Bride Street, London, and to carry on the business of importers, exporters and dealers in and manufacturers of articles of every description. The first subscribers (each with one share) are:—Paul Stern, 58, Torrington Square, W.C., electrical engineer; F. Flower, 17, Woodside, Wimbledon, manager; L. Lehmann, 68, Basinghall Street, E.C., merchant; J. B. Gomes, 26, Blenheim Crescent, Bayswater, W., manager; H. Wagstaff, 66, Shaftesbury Road, Crouch Hill, N., secretary; J. P. Lant, 67, Billington Road, New Cross, clerk; and E. F. H. Kroning, 11—13, St. Bride Street, E.C., merchant. No initial public issue. The first managing directors are P. Stern and E. F. H. Kroning; qualification, £100; remuneration, £150 each per annum. Registered office, 11—13, St. Bride Street, Ludgate Circus, E.C.

Lancashire and Grand Trunk Electric Tramways, Limited (71,218).—This company was registered on August 27th, with a capital of £100 in £1 shares, to carry on the business of constructors of light railways, producers and suppliers of electricity for the purposes of light, heat and power, rubber manufacturers, manufacturers of cycle and other tires, and rubber articles of every description, and to acquire and turn to account any patents, patent rights, &c. The first subscribers (each with one share) are:—A. T. Pendry, 3, Manor Place, Hackney, secretary; H. S. Cohen, Aynlo House, Dalston, N.E., secretary; D. J. Norris, 61, London Street, Fitzroy Square, W., clerk; G. A. Kohler, Aynlo House, Dalston, N.E., merchant; J. Gladwin, 40, Holborn Viaduct, E.C., housekeeper; W. C. Baker, 5, Gloucester Pavement, Lea Bridge Road, N.E., accountant; and R. H. Ward, 46, Fetter Lane, E.C., physician. No initial public issue. Registered without articles of association.

therefore, in the sense they had indicated by the neglect of

Dundee on Saturday, September 14th.

SUPPLY STATION ACCOUNTS.

Leeds Corporation Electricity Accounts.

FROM August, 1898, the electricity supply undertaking in Leeds has been under the control of the Corporation. The accounts previously issued dealt with the period October, 1898, to March, 1899, and from the latter date to March, 1900, between which no useful comparison could be made. The analysis of the past two years shows a steady growth and progress notwithstanding the slight increase in costs, which has caused the net profit to bulk less than in 1899. The station has now over 4,000 KW. installed, the three largest units of plant being each of 640 KW. capacity.

GENERAL STATEMENT.

	1899.	1900.	Inc.
Total capital expenditure ...	£307,522	**£368,098**	£60,576
Number of units sold	2,005,840	**2,520,414**	514,574
Maximum load in KW.	2,216	**2,514**	298
No. of 35-watt lamps connected	106,263	**132,283**	26,020
Gross revenue	£36,221	**£43,669**	£7,448
Gross expenditure...	£9,930	**£13,770**	£3,840
Gross profit	£26,291	**£29,899**	£3,608
Average price per unit sold ...	4·07d.	**4·03d.**	—·04d.

The whole of the revenue practically is derived from private supply, for although a start has been made with street lighting, the arc lamps upon the trolley wire standards are supplied from the traction station at the rate of 1½d. per unit, and are paid for at this figure by the committee having charge of the street lighting. The increase in output is about 25 per cent., with nearly the same rise in the lamps connected and about 20 per cent. in the gross revenue. The return upon energy sold has slightly fallen, and now is almost exactly 4d. per unit, being reduced to this amount by the discounts allowed on the charge of 5d. per unit for lighting and that of 2d. for motors and heating. Consumers have increased from nearly 1,400 to over 1,800.

REVENUE STATEMENT.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Sale of energy	£34,066	4·07d.	**£42,296**	4·03d.	—·04d.
Meter rents	2,155	·26d.	**1,328**	·13d.	—·13d.
Sale of lamps, &c.	—	—	—	—	—
Sundry: law costs refunded ..	—	—	**45**	·00d.	—
Gross revenue ...	£36,221	4·33d.	**£43,669**	4·16d.	—·17d.

Under Corporation management it is not surprising that wages should have slightly increased. Rates are also slightly augmented, but the only important change is in the item of coal, which shows about 50 per cent. rise. Mr. Dickinson mentioned this fact in one of the discussions at the Institution a year or so ago, and pointed out how the cheap fuel market had been affected by the general rise in price. Where the freightage is low the percentage increase in cost of fuel is necessarily high, and Leeds has felt this acutely. The figure of 1⅛d. per unit sold, for total costs, is therefore exceptionally good.

COST OF PRODUCTION.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Coal..	£2,592	·31d.	**£4,727**	**·45d.**	+·14d.
Oil, waste, water and engine room stores	361	·04d.	403	**·04d.**	·00d.
Salaries and wages incurred in generation and distribution.	2,099	·25d.	2,862	**·27d.**	+·02d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	1,113	·13d.	1,359	**·13d.**	·00d.
Works cost ...	£6,165	·73d.	£9,351	**·89d.**	+·16d.
Rent, rates and taxes ..	890	·11d.	1,359	**·13d.**	+·02d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	2,223	·27d.	2,485	**·24d.**	—·03d.
General establishment charges, stationery and printing, law charges and insurance	652	·08d.	575		—·03d.
Other expenses	—	—	—	—	—
Total costs ...	£9,930	1·19d.	£13,770	**1·31d.**	+·12d.

The financial charges have taken up more than £5,000 over the sum required in 1899, and as gross profits have fallen by £3,608 the net result has been to reduce the profit by £1,621, but £6,881 is a substantial sum to carry forward, although not a high percentage on a capital of £368,098, and no doubt, we shall see the creation of a reserve fund in a year or two.

PROFIT STATEMENT.

	1899.	1900.
Interest on loans	£12,473	£15,385
Sinking fund for repayments	5,316	7,633
Net profit carried forward	8,502	6,881
Gross profit	£26,291	£29,899

Bristol Corporation Electricity Accounts.

THE accounts covering the working last year of the Bristol Corporation electricity department contain features which are not uncommon, although hardly what would be desired. The result of the year's operations was a net loss of £2,558. This is explained by the largely increased price of coal, by interest and sinking fund on the unremunerative capital invested in the Avonbank works and by management expenses, which include the salaries of members of the staff engaged exclusively on new works, but which, by Local Government Board action, have to be charged to revenue. It is not anticipated that a material improvement in the net financial result of the trading can be shown during the current year, as although the price of coal has been considerably reduced, the unremunerative outlay is being increased, and the advantage of this outlay will not be felt until the works at Avonbank are completed and in operation.

GENERAL STATEMENT.

	1899.	1900.	Inc.
Total capital expenditure ...	£252,588	**£299,259**	£46,671
Number of units sold	1,812,511	**2,191,559**	379,048
No. of lamps connected	85,956	**114,374**	28,418
Maximum load in KW.	1,676	**2,099**	423
Gross revenue	£31,857	**£37,467**	£5,610
Gross expenditure...	£18,082	**£25,766**	£7,684
Gross profit	£13,775	**£11,701**	—£2,074
Average price per unit sold ...	3·81d.	**3·72d.**	—·09d.

The charges for private lighting range from 5d. to 2½d., and for power from 1½d. to 1⅛d. per unit. The low rates have led to an ever-increasing popularity, evidenced by an increase of 292 consumers, which brings the total to 1,507, and an addition of 30-watt lamps from 91,117 to 119,615, this exceeding in private lighting alone the total new connections in any previous year. Motive power has more than doubled the units taken at the special rate. Further, most of the new connections have been made on existing mains. The standing charge of 25s. per KW. per quarter was done away with in October, 1900. The total output is now nearly 2⅛ millions, and the average price received has fallen below 3¾d. per unit.

REVENUE STATEMENT.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Sale of energy	£28,800	3·81d.	**£33,922**	3·72d.	—·09d.
Meter rents	1,118	·15d.	**1,383**	·15d.	·00d.
Sales of lamps and old material, rental of motors, work on consumers' premises, and attendance public lamps	1,719	·23d.	**1,868**	·20d.	—·03d.
Sundry fees, rents received, and premiums	220	·03d.	**294**	·03d.	·00d.
Gross revenue ...	£31,857	4·22d.	**£37,467**	4·10d.	—·12d.

In the costs coal has risen by over ⅝d. to 1¼d. per unit. The increased price paid represented about £4,000 out of the gross difference of £5,207 between 1899 and 1900. The average prices in these years were 12s. 5d. and 18s. 7d. per ton, but in 1896 the price was only 8s. 6d. Trivial increases are shown in repairs, rent, rates, and salaries, but these are covered by reductions in the other items; thus the total cost shows an upward change equal to that in the first item of coal.

COST OF PRODUCTION.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Coal	£6,231	·83d.	£11,438	**1·25d.**	+·42d.
Oil, waste, water and engine room stores.	845	·11d.	726	**·08d.**	—·03d.
Salaries and wages incurred in generation and distribution and attending public lamps	3,824	·51d.	4,598	**·50d.**	—·01d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	1,958	·25d.	3,159	**·35d.**	+·10d.
Works costs	£12,858	1·70d.	£19,921	**2·18d.**	+·48d.
Rent, rates and taxes ..	1,767	·23d.	2,209	**·24d.**	+·01d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	1,999	·27d.	2,625	**·29d.**	+·02d.
General establishment charges, stationery and printing, law charges and insurance.	1,187	·16d.	831	**·09d.**	—·07d.
Other expenses, interest on deposits, tests, and fees of electric Inspector	271	·04d.	180	**·02d**	—·02d.
Total cost ...	£18,082	2·40d.	£25,766	**2·82d.**	+·42d.

The gross profit was less by £2,074 in 1900 than in 1899, while the financial charges required an additional sum of £529. These together meant a greater demand by £2,603, but from this must be deducted the difference between other items of net profits in the

two years, amounting to £45, leaving the net loss at £2,558. The preliminary expenses charged are certain incidentals connected with the Avonbank works, while the depreciation is taken at half the rentals received from hire of motors. It is hoped that the Avonbank works may be sufficiently advanced to allow of their supplying the coming winter load, which should materially improve the accounts for the current year.

Profit Statement.

	1899.	1900.
Interest, &c., on loans	£6,020	£7,327
Sinking fund for repayments	7,590	6,812
Net profit carried to depreciation fund	19	29
" " to preliminary expenses ..	...	91
" " forward	146	−2,558
Gross profit	£13,775	£11,701

Electrical Company, Limited.—The last balance-sheet of the above company for the year 1901 was passed at their annual general meeting. A dividend of 15 per cent. was declared, and a substantial amount added to the reserve fund, &c. The large business the company are carrying on, and the establishing of further branches, as well as the large contracts in hand, including the complete equipment of the central station for the Manchester Corporation, have made it necessary to increase the capital of the company to £100,000, which has unanimously been passed.

Hove Electric Lighting Company.—The directors have declared an interim dividend at the rate of 7 per cent. per annum, payable on October 15th next.

Commercial Cable Company.—Quarterly dividend 1¾ per cent., payable October 1st.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramways.—The receipts for the week ending August 31st were £1,154; corresponding week last year, £1,520; decrease, £366. Total to date, £12,979; corresponding period last year, £13,125; decrease, £146.

Bristol Tramways and Carriage Company.—The receipts for the week ending August 30th were £3,759; corresponding period last year, £3,455; increase, £304.

Central London Railway.—The receipts for the week ending August 31st were £5,412; corresponding week last year, £4,500; increase, £912. Total receipts from July 1st (9 weeks), £51,027. Miles open, 6.

City and South London Railway.—The receipts for the week ending September 1st were £1,952; corresponding week last year, £1,528; increase, £424. Total to date, £16,560; corresponding period last year, £13,536; increase, £3,024. Miles open, 4½.

Dover Corporation Tramways.—The receipts for the week ending August 31st were £307 1s. 7½d.; corresponding week last year, £289 0s. 10d.; increase, £18 0s. 9½d. Total to date, £7,577 15s. 5d.; corresponding period last year, £7,123 12s. 1d.; increase, £454 3s. 4d. Miles of track open, 3. Car miles run, 1901, 5,379. Number of cars, 1901, 12; 1900, 11.

Dublin United Tramways Company.—The receipts for the week ending August 30th were as follows:—D.U.T. Co., electric cars, £4,120 16s. 6d.; D.S.D. Co., electric cars, £1,520 18s. 7d.; total, £5,611 15s. 1d.; corresponding period last year—D.U.T. Co., electric cars, £4,227 2s. 11d.; ditto, horse cars, £29 18s. 6d.; D.S.D. Co., electric cars, £1,629 19s. 7d.; total, £5,886 16s. 0d.; decrease, £245 0s. 11d.; aggregate to date, £46,706 18s. 6d.; aggregate to date last year, £44,961 9s. 5d.; increase, £1,745 9s. 1d. The mileage worked is 45 miles electrically, as against 42 miles electrically, and two miles by horses, for the corresponding period last year. (Horse show, 1900 and 1901.)

Liverpool Overhead Railway.—The receipts for the week ending September 1st were £1,670; corresponding week last year, £1,735; decrease, £65. Total from July 1st to date, £15,754; corresponding period last year, £15,695; increase £59. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

The money market remains as easy as ever, and short loans can be arranged with ridiculous cheapness from the lenders' point of view. An instalment upon the new Consols fell due on Thursday, September 5th, but there was any amount of capital available for meeting it. And yet Consols are markedly flat. The dividend has been deducted, making the price look cheap enough, and there is a fair-sized Bear account in the stock, but nevertheless the quotation displays no strength, and gives no assistance to other investment markets round the Stock Exchange. The latter, however, are taking matters into their own hands, as we hinted last week. Investors are certainly turning their attention to Capel Court, and good buying of first-class securities is raising the price of such stocks as Telegraph and Electric Supply Debentures all round. The industrial section is also awakening; at least, people with money are awaking to the good purchases to be found in its lists, and the demand at present is mainly for electrical undertakings. National Telephone issues keep good upon the prospect of Government negotiations proving satisfactory to the company.

It is a singular anomaly that now exists between the prices for National Telephone 3½ per cent, and the 4 per cent. Debenture stocks. The former is up three points this week, and is nominally quoted at the same figures as the 4 per cent. Debenture. But in the market it commands a better price than the better dividend-payer, which it should not do intrinsically, for although the 4 per cent. ranks after the 3½ stock, yet it ought to stand at least two points above it. Of this 4 per cent. Debenture stock there is but half a million authorised and issued, while there are two millions of the other. The 4 per cent. can be bought at a trifle over 97, and a broker should be able to purchase it free of stamp and fee to his client, thus saving the ½ per cent. *ad valorem* duty payable to the Inland Revenue on registered stock. We consider that it is fully worth par. Both First and Second Preference shares have recovered the 6s. per share dividend deducted last account-day.

A security worth attention is Eastern Extension shares—"Chinas," as they are popularly known in the market. From these a yield of 5 per cent. upon the money invested can still be obtained. In the ordinary course of events Eastern Extensions are quoted on all fours with Eastern Telegraph stock, but the latter is now up to 145½, equivalent to 14½ for "Chinas." The company's 4 per cent. Debenture stock shows another small rise this week, and advances of 1 per cent. are observable in Eastern Telegraph Preference and Debenture stocks, both following upon appreciations last week.

In the Anglo-American group, Submarine Cable Trusts are harder, and there has been quite a spurt in Anglo descriptions. The Deferred is as high as 11, upon what is euphemistically described in the Stock Exchange as "good speculative buying." They are even talking about a dividend on the Deferred, ranging from 5s. to 10s. per cent., although a fortnight ago, when Anglo "A" dropped to 9½, the dealers discussed the stock with deep lugubriousness. The ordinary is good at 54½, a rise of 2 per cent., and the Preferred has got as high as par. West African Debentures are quoted *ex* the dividend, and are practically ½ better, but Cuba Telegraph Debentures have again fallen half-a-sovereign.

In the electricity supply market the alterations are nearly evenly divided between losses and gains. Brompton and Kensington Preference are weaker; so are City of London Preference and County of London Ordinary. The little revival in City shares upon the appearance of the hopeful report has lost its power, and the market in them is not a particularly strong one. South Londons are nominally 3, but Westminsters are strong and St. James's Ordinary are also in request. Edmundson's Debenture is better, and the general trend of this market keeps distinctly good. There are none too many shares about, and when a buyer of any quantity puts in an appearance it means the prices going up at the same time.

The traction section displays no notable changes. British Electric are steady, and the dealers report that there is good support for the shares. "Americans?" we asked. "No, English," was the emphatic reply. The Ordinary are ¼ up. London United Tramways Debenture is changing hands in the neighbourhood of 106. Imperial Tramway shares at 22 keep firm. Business in them has been but slightly stimulated by the developments in West London, and the bulk of orders in shares still goes to Bristol.

The little electric railway market shows considerable strength, and home rails, as a whole, seem to be tentatively casting the aspect of gloom that has enshrouded them so long. Central Londons are better on the week, and another rise of a point has left Waterloo and City Ordinary at 94½. The market looks with unruffled countenance upon the experimental change of locomotive power upon the "Twopenny Tube," arguing that whatever outlay or alteration may be now required it can only temporarily affect the company's position, and that the abundant harvest of passengers which the line now reaps every day is not likely to fall off. Metropolitan Consolidated at 80 is dull, the deadlock over the "system" dispute tending to uneasiness amongst stockholders. Districts keep at 30.

Henleys and Callenders are in good request, and there seems to be no reason why the prices should not further improve. The manufacturing division has been quiet for too long already, but, as we pointed out in our opening paragraph, there are indications that this section is about to receive the attention which it deserves. Edison & Swan have risen from being sellers at 2s. 6d., less than nothing, to nearly 7s. 6d. per share. Holders were actually offering them for nothing, with a bonus of ¼ to anybody who would relieve them of the liability on the shares. These have been picked up, and now the market is short of them. Added to this, some people sold shares which they could not deliver, so that a few buying orders from people who want to average their holdings, proved all that was necessary to raise the price from its "rubbish" quotation. But it is doubtful whether the Ordinary shares have any intrinsic value whatever, as the company is at present constituted, although they may possess some speculative worth.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotations Aug. 28th.	Closing Quotation Sept. 4th.	Business done during week ended Sept. 4th, 1901. Highest.	Lowest
96,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —102	99 —102	...	...
119,700*l*	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	78 — 83	78 — 83	...	...
822,700*l*	Anglo-American Telegraph	Stock	£3 9s.	73/6	3½%	51 — 54	53 — 55	...	...
3,088,540*l*	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	97 — 99 xd	98 —100	100	97½
3,088,540*l*	Do. do. Deferred	Stock	18s. %	£1 7s.	5s.%	10 — 10½	10⅜— 11¼	11	10½
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	5 %	3¾— 4¼	3½— 4	3⅝	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	175 —185 xd	175 —185	...	...
1,589,496*l*	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	101 —103	101 —103	102½	...
16,000	Cuba Telegraph	10	8 %	7 %	...	5 — 6	5 — 6	...	...
6,000	Do. 10 % Pref.	10	10 %	...	...	14 — 15	13½— 14½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	9 — 10	9 — 10	...	...
30,000*l*	Do. do. 4½ % Debs.	50	...	...	...	100 —104	100 —104	...	...
60,710*l*	Direct United States Cable	20	3½%	3½%	3½%	10½— 11½	10½— 11½	11	10⅞
104,300*l*	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	143 —148	143 —148	145½	143
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	96 — 99	97 —100	...	...
1,432,268*l*	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	114 —117	115 —118	115	...
300,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	13¾— 14¼	13¾— 14¼	14⅛	14
320,000*l*	Do. 4 % Deb. Stock	Stock	...	...	...	114 —119	115 —120	118	...
300,000*l*	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	5¼ %	...	100 —103	100 —103	102	...
200,000*l*	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	101 —104	101 —104	...	...
180,227	Globe Telegraph and Trust	10	5⅛%	5¼%	5¼%	10½— 11	10½— 11	10⅞	10⅝
180,042	Do. do. 6 % Pref.	10	6 %	...	...	14¾— 15¼xd	14¾— 15¼xd	15⅛	14⅞
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	15 %	31 — 33	31 — 33	31 5/16	31¼
78,000*l*	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	41 — 45	41 — 45	...	...
100,000*l*	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	105 —108	102 —105 xd	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680	1	...	2½%	...	¼— ½	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	½— 1	½— 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	3⅞— 4⅛	3¾— 4 xd	3⅞	3 13/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅜ — 5	4⅝ — 4⅞xd	4⅝	...
2,000,000*l*	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	92 — 95	95 — 98	97½	95½
500,000*l*	Do. 4 % Deb. Stock Red.	100	...	...	4 %	95 — 98	95 — 98	96½	96¼
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	⅞— 1	⅞— 1	...	...
100,000*l*	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	...	...	...	100 —103	100 —103	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	...	...
3,361	Submarine Cables Trust	Cert.	...	...	...	126 —131	127 —132	...	...
58,000	United River Plate Telephone	5	6 %	7 %	...	5 — 5¼	5 — 5¼xd	5⅜	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4⅜— 5¼xd	4⅜— 5¼ xd	4¾	...
179,947*l*	Do. do. 5 % Debs.	Stock	...	...	...	102 —105	102 —105	...	...
171,000	West African Telegraph, 5 % Debs.	100	...	...	...	101 —104	99 —102 xd	100½	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ⅜	¼— ⅜	...	...
150,000*l*	Do. do. 4 % Debs., 1—1,500 gua. by Brzs. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	14 — 14½	14 — 14½	14⅜	14⅛
75,000*l*	Do. do. 5 % Debs. 2nd series, 1906	100	...	...	...	102 —105	101 —104 xd	...	...
348,777*l*	Do. do. 4 % Deb. Stock Red.	100	...	...	...	102 —105	101 —104	...	...
88,321	West India and Panama Telegraph	10	2 %	8%	...	¼— ½	¼— ½	5/16	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	...	...	...	5 — 6	5 — 6	5 1/16	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	...	...	...	3 — 5	3 — 5	...	...
80,000*l*	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	101 —104 xd	101 —104 xd	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7⅞— 8¼	7⅞— 8¼	...	...
12,000	Do. do. 7 % Cum. Pref.	5	...	...	...	8¼— 9	8¼— 8⅝xd	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9 — 10	9 — 10 xd	9¼	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5½— 5⅝	5½— 5⅝xd	5 9/16	5 7/16
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	5½— 6	5½— 6	...	...
150,000*l*	Do. do. do. % Deb. Stock Red.	Stock	...	...	...	107 —110 xd	107 —110	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579	10	6 %	4 %	0 %	8 — 9	8 — 9	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12 — 13 xd	11½— 12½	...	...
400,000*l*	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	120 —125 xd	120 —125 xd	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	4 %	4 %	8½— 9½	8 — 9 xd	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	12 — 13	12 — 13 xd	12½	12¼
200,000*l*	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd.	...	...	...	...	103 —106 xd	103 —106 xd	105½	104
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	6 %	7 %	5½— 6 xd	5⅝— 6¼	5⅞	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5½— 6 xd	5½— 6	...	...
120,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock.	100	...	...	...	102 —105 xd	104 —107	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11 — 12 xd	11 — 12	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104 xd	101 —104	102¾	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	1½— 1⅝	1½— 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	4 — 5	4 — 5	...	...
250,000*l*	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	96 —100	96 —100	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	13 — 14	13 — 14 xd	13⅝	13⅜
220,000*l*	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	108 —111 xd	111 —114	...	...
250,000*l*	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	94 — 97 xd	97 —100	...	...
6,452	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15 — 16 xd	15 — 16	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½xd	15 — 16	15⅝	15¼
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½xd	8½— 9⅜	...	...
150,000*l*	Do. do. 3½ % Deb. Stock Red.	100	...	...	...	97 —100 xd	97 —100 xd	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000*l*	Do. do. 4 % Deb.	100	...	...	...	80 — 90 xd	80 — 90 xd	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3½	2 — 3	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	12 %	13 %	10½%	11½— 12½	12 — 13 xd	12 9/16	12¼

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
‡ Quotations on Liverpool Stock Exchange.
† Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years.			Closing Quotation Aug. 21st.	Closing Quotation Sept. 4th.	Business done week ended Sept. 4th, 1901.	
		‡	1898.	1899.	1900.			Highest	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	7 — 8	7 — 8	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	89 — 93	89 — 93	...	...
45,000	British Electric Traction	10	6 %	8 %	9 %	13⅜— 14¼	14 — 14½	14½	14 1/16
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	11⅜— 12¼xd	11⅜— 12¼	12 1/16	11 15/16
350,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	122 —125	122 —125	125	123⅜
70,000	British Insulated Wire Ord.	5	15 %	20 %	15 %	9½— 10½	8 — 9	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	6 — 6½xd	5¼— 5⅜	5 1/16	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	...	8 %	⅞— 1	⅞— 1	...	...
50,000	¶ „ „ „ 6 % Cum. Pref.	£1	...	...	6 %	1 5/16— 1 1/16	1 5/16— 1 1/16	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	2	5 %	6 %	...	1½— 1⅝	1½— 1¼	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2 — 2¼	2 — 2¼	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	103 —108	103 —108	...	...
108,710*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	99 —102	99 —102 xd	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	15 %	14½—15½	15 — 16	15½	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5⅜— 6¼	5⅜— 6¼	6 1/16	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	108 —112	110 —114	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	...	99 —102	102 —105	104¾	103½
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	...	103 —106	105 —108	...	...
440,100	Do. do. Def. do.	Stock	...	...	...	98 —101	98 —101	...	...
855,000	City and South London Railway	Stock	2⅛%	1⅞%	1¼%	52 — 54 xd	52 — 54 xd	53	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	5¼— 5⅜	5¼— 5⅜	...	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½%	8 %	3¼— 3⅜xd	3¼— 3⅜	3 9/16	3 7/16
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	100 —105	100 —105 xd	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	2½%	0 — ¼	¼ — ½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	2½%	1½— 2½	1½— 2½	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	80 — 85	80 — 85 xd	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	85 — 90	85 — 90	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1½— 2	1½— 2	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	...	...	2¼— 2⅜	2¼— 3⅜	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	98 — 02 xd	98 —102 xd	100½	100
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	9⅜— 10¼	9⅜— 10¼	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	99 — 102	99 —102	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	20 %	16 — 17	16½— 17½	17	16 11/16
35,000	Do. do. do. 4½ % Pref.	5	...	4½%	4½%	5½— 6	5½— 6	5 13/16	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	21⅝	21½
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	101 —104	101 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¼%	3⅜%	3¼%	7⅛— 7⅜	7 3/16— 7 5/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5	...	13¼— 13½	12⅜— 13	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	...	6 %	19/- to 20/-	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	38 — 42	38 — 42	...	...
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...%	...	104 —106	104 —106	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	8 %	12 %	12 %	10½— 11½	10½— 11½	11¼	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5⅜— 6¼	5⅜— 6¼	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	92 — 95	93 — 96	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 1/-—3/-
National Electric Free Wiring, 17/6 paid, ⅛—⅜.
* From Birmingham Share List.
¶ From Manchester Share List.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16.
Do. do. Pref. (£10 pd.), 10⅛—10⅜.
*T. Parker, £10 (fully paid), 16½.

Bank rate of discount 3 per cent. (June 13th, 1901).

MARKET QUOTATIONS, Wednesday, September 4th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	32/-	32/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a „ „ ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£15	£15	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£22	£22	..
a Lead, Nitrate	per ton	£24	£24	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirits	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	5½d.	5½d.	..
a „ Caustic (75/80%) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	80/-	80/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£8	£8	..
Bichromate, casks ..	per lb.	2¾d.	2¾d.	..

METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b „ Wire, in ton lots	per ton	£224	£224	..
b „ Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £140	£75 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	7¾d.	..
c Tube (brazed)	per lb.	10d.	10d.	..
c „ „ (solid drawn) ..	per lb.	8¾d.	8¾d.	..
c „ Wire, basis	per lb.	8d.	8d.	..
c Copper Tubes (brazed) ..	per lb.	11d.	11d.	..
c „ „ (solid drawn) ..	per lb.	10¾d.	10¾d.	..
g Copper Bars (best selected) ..	per ton	£82 to £83	£82 to £83	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£82 to £83	£82 to £83	..
g „ Rod	per ton	£82 to £83	£82 to £83	..
e „ (Electrolytic) Bars ..	per ton	£82	£82	..
e „ „ Sheets ..	per ton	£90	£90	..
e „ „ Rod ..	per ton	£84	£84	..
e „ „ H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f „ Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/8½ to 3/9½	3/8 to 3/9	½d. inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants) ..	per ton	45/4	45/4	..
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	59/- to 62/6	59/- to 62/6	..
i „ Wire, galvanised No. 8 ..	per ton	£10	£10	..
g Lead, English Ingot	per ton	£12 to £12 2 6	£12 to £12 2 6	..
g „ „ Sheet	per ton	£13 5	£13 5	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9	£9	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d „ „ „ medium ..	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large ..	per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/8	1/0½ to 1/8	..
p „ rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ „ strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10½d. to 1/0½	10½d. to 1/0½	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40	From £15 to £40	..
i „ „ in bars		£58	£58	..
g Tin, block	per ton	£118 10 to £119 10	£119	..
g „ foil	per lb.	1/6	1/6	..
n „ wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals — "White Ant" brand	per ton	£35 to £65	£35 to £65	..
j Yarns, Cotton, Single 10 lb. b'ndl's	per lb.	..	..	..
j „ Best Flax, 6 lea.	per lb.	..	..	..
j „ Hemp, 3 ply 10 lbs. ..	per lb.	..	..	..
j „ „ Russian, 10 lbs. ..	per lb.	..	..	..
j „ Jute, 180 lbs. rove ..	per ton	..	..	..
k Zinc, Sh't. (Vielle Montagne bnd.)	per ton	£22 10	£22 10	..

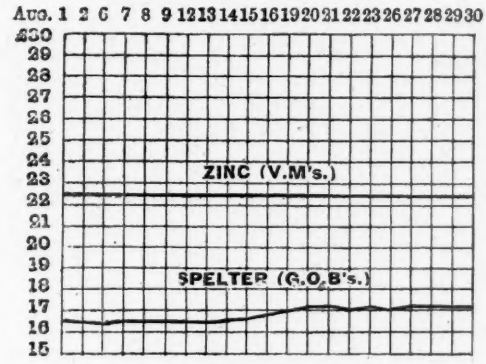
Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works Co., Ltd. g Messrs. James & Shakspeare. h Messrs. Jackson & Till. i Messrs. Bolling & Lowe. j

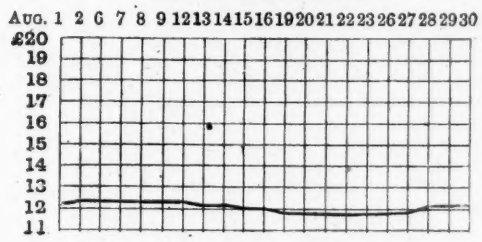
Quotations supplied by { k Messrs. Morris Ashby, Limited m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

METAL MARKET.

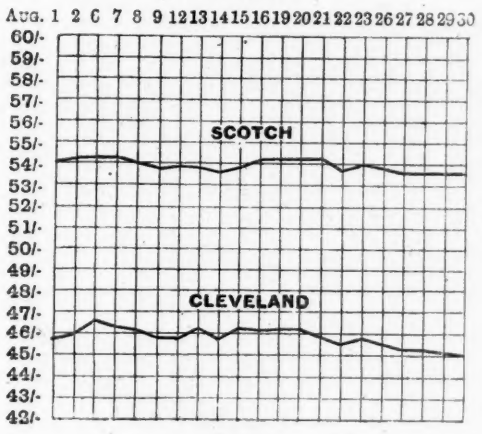
Fluctuations in August.



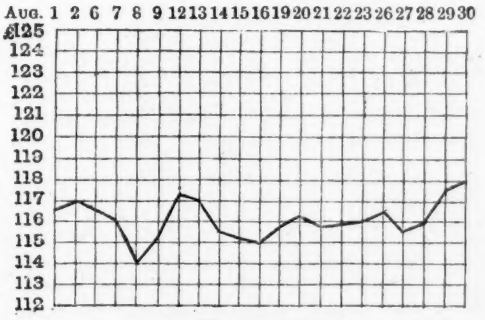
LEAD (ENGLISH).



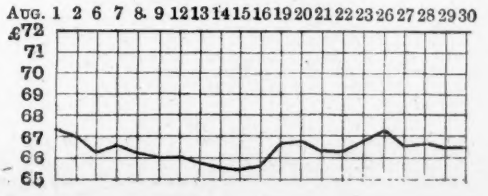
IRON.



TIN.



COPPER (G.M.B's.)



CURRENT SPECIFICATIONS.

LXXVII.—LONDON COUNTY COUNCIL TRAMWAYS.

Summary.

Extent of Contract.—Section B. Supply and erection at Loughborough Junction of two 1,500-kw. steam dynamos, and the supply and erection at Greenwich of two 150-kw. steam dynamos.

Type of Engines for Large Sets.—To be of inverted vertical type, and may be either suitable for compound or triple-expansion working. Speed not to be less than 100 revolutions per minute, but may be greater at option of tenderer.

Available Steam Pressure.—180 lbs. to 200 lbs. per sq. in., engines to work either condensing or non-condensing.

Range of Governing.—Momentary variation not to exceed 10 per cent. when the whole load is thrown off, and the permanent variation under similar circumstances not to exceed 3 per cent. To maintain control of engine from no load to 20 per cent. overload.

Output of Dynamos.—Normal output 1,500 kw., 2,400 amperes at 625 volts. Compound winding to raise volts at terminals from 550 volts at no load to 625 volts at full load. To be capable of giving 625 volts at no load when run as shunt machine.

Overload.—To be capable of giving 20 per cent. overload in current, viz., 2,880 amperes for period of one hour.

Type of Engines for Small Sets.—To be high-speed enclosed direct-acting engines, to run at not more than 350 revolutions per minute.

Steam Pressure.—The steam pressure at Greenwich will be 190 lbs. per square inch, and the engines for the small sets are to work either condensing or exhausting to atmosphere.

Range of Governing.—To be similar to requirements for large engines, excepting that the permanent variation may not exceed 5 per cent. when the whole load is thrown off.

Dynamos.—To be shunt wound to give variation at terminals between 200 and 225 volts. The requirements as to overload for the larger sets are not to apply.

Permissible Temperature Rise.—Not to exceed 70° F. after six hours' full load run.

High Voltage Insulation Test.—Half an hour at 1,000 volts alternating between frame and armature and field winding with all brushes down.

Steam Consumption Requirement.—When working condensing with 190 lbs. steam and 24-in. vacuum not to exceed with either set at full load 24 lbs. per kw.-hour, and when working non-condensing under otherwise similar conditions, 30 lbs. per kw.-hour.

Bonus and Penalty.—£300 per pound, or *pro rata* for fractions of a pound, and for the small sets £25 per pound or *pro rata* for fractions of a pound. If the figures exceed 28 lbs. per kw.-hour, condensing, or 35 lbs. per kw.-hour non-condensing, the sets may be rejected altogether by the Council.

Specified Date of Delivery.—Not to exceed for the two large sets 12 months from date of order, the two small sets as soon as possible.

Penalty for Late Delivery.—For large sets, £25 per set per week for each week beyond guaranteed dates, and for the two small sets £15 per set per week for delay beyond guaranteed dates.

Terms of Payment.—50 per cent. of value of work delivered on site, 30 per cent. additional when work has been completed. Another 10 per cent. on plant being taken over, and last 10 per cent. at end of period of maintenance.

Period of Maintenance.—Twelve months from date of completion.

Stipulations as to Removal of Foremen.—Acceptable.

Stipulations as to Wages to be Paid to Workmen.—The claims of the Council under this head are very stringent. See comments below.

Arbitration Proposals.—Unsatisfactory. See comments below.

Date for Receipt of Tenders.—October 8th, 1901.

This interesting specification is for the first portion of the electrical plant which will be required for the electric tramways on the south side of the river, owned and worked by the London County Council. It has doubtless been prepared by Prof. A. B. W. Kennedy, F.R.S., the consulting electrical engineer to the Council, and is issued by the Engineers' Department of the Council. The present instalment of plant is for two 1,500-kw. steam dynamos, to be erected temporarily in the generating station of the South London Electric Supply Corporation at Loughborough Junction, and two 150-kw. steam dynamos to be erected in the Council's own generating station at Greenwich. At this station large three-phase units will be installed, and the present sets are for use for exciting and power purposes at the station.

The Tooting line of cars, which is the first to be altered to electric traction, will for a time be worked by the plant installed at Loughborough Junction.

In view of the importance of working a portion of the system electrically as soon as possible, the erection of the 1,500-kw. sets at the South London Company's station seems to be the best solution of the difficult position in which the Council was placed.

The steam pressure available, both at Loughborough Junction and Greenwich, will be 190 lbs. per sq. in., and the engines for the larger sets may be either compound or triple-expansion. Vertical inverted engines, to run at not more than 100 revolutions per minute, are specified for the 1,500 kw. sets, while the small sets are to be of the enclosed high-speed type. The larger sets are to be capable of working for periods of not more than one hour at 20 per cent. overload, and after their re-erection at Greenwich, when the new station is in thorough working order, the sets will be worked condensing. No overload is required for the small sets.

The technical details given in the specification are such as can be met by high-class engine builders; the annoying details and requirements given in some recent specifications are conspicuous by their absence.

The dynamos are to be manufactured by some firm which has already made machines of 500-KW. output. They are to be capable of giving full output either as shunt or compound machines at 625 volts, the series winding raising the terminal volts from 550 volts at no load to 625 volts at full load. The sets are to be tested after erection for steam consumption, and, curiously enough, the same figures are demanded from each set, the bonus and penalty for variations from the specified figures being of course different with the two sizes of plant.

When working at full load, supplied with steam at 190 lbs. pressure, and exhausting to a vacuum of 24 in., the steam consumption must not exceed 24 lbs. per KW.-hour, or when exhausting to atmosphere, but otherwise working under similar conditions, 30 lbs. per KW.-hour. If these figures are improved upon the Council will pay a bonus at the rate of £300 per lb., or *pro rata* for parts of a lb. of steam saved, and if the figures are exceeded will demand from the contractor penalty at the same rate. The bonus and penalty for the smaller sets will be at the rate of £25 per lb., or *pro rata* for fractions of a lb. The Council reserve the right to totally reject the sets if the figures obtained on test exceed 28 lbs. and 35 lbs. respectively.

Prices are asked for in detail, and a number of schedules have to be filled in, giving full particulars as to the plant tendered for.

It is open to tenderers to make offers for their standard sizes and types of plant, provided that these do not differ widely from the specification.

A sum of £2,000 is reserved in the total contract sum to be expended at the discretion of the engineer.

Completion of erection of the two large sets is required within 12 months of date of order, and earlier if possible, under a penalty of £25 per set per week, and the two small sets as soon as possible, under a penalty of £15 per set per week.

Referring to the general conditions, we find they consist of the latest regulations under which the London County Council are at the present time prepared to let engineering contracts. As now drafted, they are an improvement in some respects upon earlier forms which have come under our notice, but they still contain very objectionable features, and are, in our opinion, far from being fair to all parties.

Dealing, first of all, with the arbitration clause, we find that this refers the final decision in any dispute to Sir Alexander Richardson Binnie or other the chief engineer for the time being to the Council. For reasons which we have at various times detailed at length in this series, we advise intending contractors to object strongly to this proposal. It is unfair to the gentleman holding the position referred to that, being the paid servant of the Council, he should be called upon to act as *judge* in a case where his own employers are one of the *parties* to the case submitted to him for decision. The high reputation of the gentleman acting under the specification as *judge* may result in his decision being unquestioned by either party, but we repeat that the position is an anomalous one, and, on principle, should be objected to by all parties concerned. We are aware that it is stated that in such a case as the present the person appointed as *arbitrator*, although a servant of the Council, has had no actual part in the drawing up of the specification, and that he therefore approaches the subject without bias, and so far acts as if he were an independent arbitrator; but this does not affect the principle. Whether the purchasers are the great State departments, railway companies, or important municipal authorities there ought in all large contracts to be some means by which in cases of dispute an *absolutely independent* hearing and decision on the case can be obtained by either party.

The terms of payment are acceptable, provision being made for payments up to 80 per cent. on completion of erection, an additional 10 per cent. on taking over, and the final 10 per cent. at the end of the 12 months' period of maintenance.

The labour conditions are in our opinion highly objectionable. They go far beyond the right of any purchaser to ask whether fair wages are paid to workmen employed on any specific contract, and dictate what rates shall be paid and hours worked by the whole of the manual labourers employed on the contract.

The principal clauses were reprinted *in extenso* in our issue of September 7th, 1900, when criticising the specification issued for the generating plant for the Horton Estate Asylum. As then stated, we recognise the right of any purchaser to satisfy himself that the conditions, under which goods purchased by himself are manufactured, are fair and reasonable in the opinion of an independent impartial authority, but we do not consider that beyond this he has any right to interfere.

We strongly recommend all tenderers to protest against the stipulation that it shall be open for the clerk to the Council to direct the contractor to produce, to such officer or officers of the Council as he may select, their time and wages books, and sheets relating to this contract. These books are the private property of the contractor, and ought not to be at the mercy of the purchaser or his agents. If it is justifiable for the London County Council to make such a claim, there is no reason why the custom should not be extended, and what, may we ask, would be the result if everyone exercised such a power?

Many manufacturers will also, in our opinion, rightly object to the clause stipulating that a copy of the rates of payment and conditions of labour stipulated in the seventh schedule attached to this specification shall be publicly exhibited in their factories and wherever work is done on this contract.

We recommend that tenderers carefully read the whole of the conditions before sending in their offers, and that they point out to the Council in their covering letters the points open to objection. In this specification some points have been modified in such a manner as to accord more with usual practice, and it is possible that a continuance of the protests which have from time to time been made against the unfair and unjust stipulations in the past insisted upon by the Council, may result in the adoption of a standard set of conditions fair and just to Council, workpeople and contractor alike.

A NEW FORM OF OIL BREAK FUSE.

THE need of a really satisfactory fuse, and the difficulty of obtaining it, have, in many instances, necessitated working without such in places where they would otherwise have been used to advantage. Messrs. S. Z. de Ferranti, Limited, have furnished a remedy for this by manufacturing an oil break plug fuse which, combined with a special type of contact block, can be added to any circuit, fixed on to any type of switchboard, or even on to the wall in a central or sub-station.

Our illustrations represent this useful device, fig. 1 showing the plug fuse in position. The cable will be seen entering from the top, although the block can easily be mounted in the reverse direction for the cables to enter from below. The withdrawal of a fuse from its contact is effected by hand, no special tool, or, in fact, any apparatus being required for this operation. Fig. 2 shows the block attached to the wall or switchboard after the removal of the fuse. It will be seen from this illustration how securely the metal sockets are shielded by the surrounding porcelain. It is quite impossible

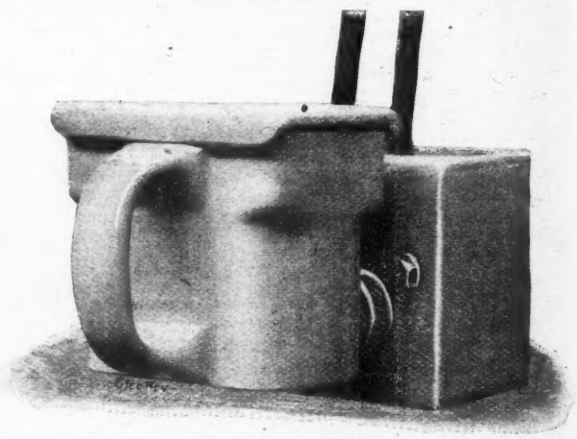


FIG. 1.

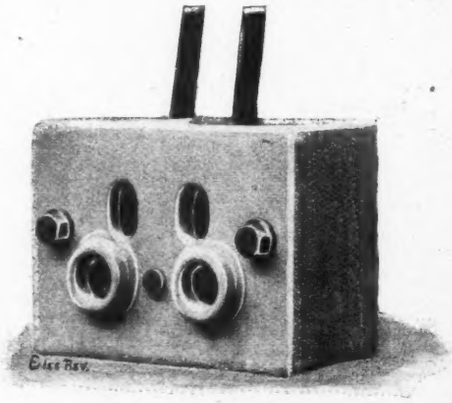


FIG. 2.

to make accidental contact with either the metal terminals or the plug sockets, both these fittings being out of sight under the surface of the porcelain. The metal fittings are held into the porcelain block by sulphur compound, and this compound is recessed where the cables enter, so that the rubber or paper covering can pass the socket so formed. By these precautions, a method of sealing the end of the cable is obtained, at the same time preventing the exposure of the live cable end.

This useful combination is produced in several popular sizes for capacities varying between 30 and 850 KW. It is equally applicable for 500 volts D.C. or 2,000 to 5,000 alternating current circuits. Even on 250-volt circuits, it is found that the oil break fuse will be advantageous where an inductive circuit is likely to be broken. Experiments have shown that the usual strip type of fuse, in blowing, causes considerable damage to the fuse contacts and to the surrounding parts of the switchboard; whereas an oil break fuse will act on the same circuit without a disturbance.

It is unnecessary to describe the details of the actual fuse, which is of the well-known Ferranti type, in which the arc produced on the break of a circuit is drawn into a bath of oil and so immediately damped. It is interesting to note the care which has been taken in producing a safe apparatus. This feature is one of the characteristics of the manufacturers, and needless to say, it is an essential one, especially when dealing with high pressure systems.

ELECTRICAL POWER MAINS REGULATIONS.

The Electrical Power Mains Regulations Committee was appointed by the Electrical Section of the London Chamber of Commerce in February, 1901, with a view to considering whether and what modifications are desirable in the existing Board of Trade rules and regulations affecting electric power supply and transmission, having regard to the situation created by the passage of the Electric Power Acts in the Session of 1900. The names of the members were given in our last issue.

The general course adopted by the Committee was to obtain the opinions of its members and others interested as to the adequacy of the existing Board of Trade regulations, and also as to the special regulations imposed in the Manchester, Midland Corporation, and Walker-Wallsend power supply undertakings, these being the only important electric power transmission schemes which had been attempted so far in this country. The Committee further decided that it would be of importance to compare regulations existing in foreign countries as to electric power transmission and supply, notably Switzerland, Germany, France, and the United States of America.

The leading points which came under discussion and investigation were as follows:—

1. The maximum tension in volts to be used for a transmission of electrical energy at extra high pressure.
2. The maximum energy in KW. allowed to be transmitted through any one cable, and whether trunk mains must always be laid in duplicate; also the manner of laying the trunk mains.
3. The supply of a metal sheath of electrical continuity round the extra high-tension cables, and this sheath to be other than the lead covering.
4. The thickness of dielectric in underground extra high-tension cables.
5. The employment of bare wire overhead transmissions in suitable rural districts.
6. The nature and construction of sub-stations and the maximum energy to be allowed in any one sub-station; also the amount of obligatory attendance in a sub-station.
7. The maximum pressure allowed on consumers' premises.
8. The inspection of the lines and earthing devices, &c.

These questions were carefully considered in the course of numerous meetings of the Committee, in the light of foreign practice, in regard to which the regulations referred to were obtained. It was found that in the Continental countries referred to, regulations exist in regard to public safety, and the safety of telegraphic and telephonic lines and of the lines of other electric power transmissions in the same districts, which taken as a whole are more favourable to the free development of undertakings of this nature than the existing regulations in Great Britain.

The Committee arrived at the conclusion that an effort should be made to procure some modification of the existing Board of Trade regulations, and their views were embodied in a letter issued by the secretary of the London Chamber of Commerce to Mr. A. P. Trotter, electrical adviser to the Board of Trade, enclosing a memorandum of the views of the Committee, and asking permission for a deputation to visit the Board.

The memorandum read as follows:—

1. *Voltage of Supply.*—Speaking generally, the Committee submit that the Board of Trade should be prepared to sanction distributing systems at voltages at least up to 20,000 volts between any two conductors, on the undertakers describing and adopting an approved method of working, and on the understanding that precautions are adopted similar to those which have been found successful in other countries. The Committee do not think that an arbitrary limit should be fixed even at 20,000 volts, as cases may arise where higher voltages are desirable; but, in such cases, admit that undertakers might reasonably be asked to specify in detail, for the approval of the Board, the character of the extra precautions they propose to adopt.

2. *Power Conveyed by Mains.*—The Committee consider that limitation of the size of mains, or the output which they may carry, is unnecessary and incompatible with natural development, though they think that the Board might reasonably require that undertakers should as far as possible arrange their system of mains to include an alternative route in case of accident. Where, however, more than 2,000 KW. is habitually to be transmitted by one main the undertakers might be required to notify the same to the Board of Trade for the purpose of record; and the Committee would regard as reasonable a regulation to the effect that, after exceeding a capacity of 8,000 KW., a central station should not transmit more than one-fourth of its total energy by one set of mains without notification to the Board of Trade; but that not more than two sets of mains should be required up to 4,000 KW.

3. *Laying and Protecting of Cables.*—The Committee strongly urge on the Board of Trade that the regulations under this head should be open and elastic. Most of the power transmission work which has been done abroad has been carried out by means of overhead wires, and there do not exist at present such large and complicated networks of underground mains for power distributions as are contemplated in the power distributions in this country. There can be no doubt that the use of underground mains on a large scale will ultimately lead to great improvements, diminishing their cost and increasing their efficiency, and it would be highly undesirable that rigid regulations should be laid down before experience has been acquired, and thus stand in the way of legitimate experiment, development or invention, and place undertakers in this country at a disadvantage compared with undertakers abroad. Where the conductors are interwoven into a single cable and where the neutral point of the system is earthed the Committee submit that the use of a metal sheath in addition to the lead covering should be optional, provided suitable mechanical protection is afforded.

4. *Thickness of Dielectrics in Cables.*—The Committee would point out that they can find no rule in any country abroad or in America making a particular thickness of dielectric compulsory. They submit that the present Board of Trade rule is not founded on any scientific basis, and since it was made further advances have shown that great thickness of dielectric is sometimes actually a disadvantage. Abroad, makers after careful experiment have successfully adopted much thinner layers with advantage, while there is a great saving in cost. The Committee suggest that undertakers and cable makers should be left to settle this matter between themselves.

5. *Permission to Use Bare Overhead Conductors.*—The Committee would particularly point out the fact that the Board of Trade regulations have hitherto practically entirely prohibited overhead work in the United Kingdom except under such onerous regulations as to make it impracticable. There are large areas in this country and in the districts over which power supply Bills have been granted the character of which is similar to districts where bare overhead wires have been successfully and safely used on the Continent and in America at very high voltages for the past ten years. The great development of power transmission on the Continent and in America has been largely by bare overhead wires in a form which has been entirely prohibited in this country, and great industries have arisen based on their use which have no counterpart here at all. The Committee are strongly of opinion that permission to use overhead wires outside crowded city areas is vital to the commercial success of power schemes over large districts, and suggest that on this point the regulations should be brought into line with those current in other countries.

6. *Sub-stations and Transformers on Consumers' Premises.*—The Committee consider that undertakers should be permitted to place transformers up to the voltages contemplated above on consumers' premises in sub-stations above or below ground, provided they are properly designed, drained and ventilated; and that the amount of power to be installed in sub-stations should be left to the undertaker's discretion.

June 7th, 1901.

In an appendix voluminous extracts from the official regulations for electric power supply in Switzerland, Germany, France, and the U.S.A. are given, which we briefly abstract below:—

Switzerland.—Clauses defining the official form of control of high power installations, the responsibility of undertakers, rights of expropriation, and penalties for wilful damage or negligence, are given, but the actual details of the high-pressure lines, &c., are left entirely open. The Swiss Institution of Electrical Engineers, however, provides the necessary regulations for safety.

High-pressure systems are defined as those of more than 1,000 volts. The maximum pressure allowed in houses and factories is 250 volts, unless expert attendance is employed. In high-pressure systems no repairs to the line or apparatus are allowed while the lines are alive, unless in cases of urgent necessity, and under the surveillance of the engineer-in-chief or his representative. Instructions as to earthing or insulating the machines are given; high-pressure parts of opposite polarity must not be placed so that they can be touched simultaneously.

The limiting temperature of apparatus, due to the passage of electricity, is placed at 60° C. Cut-outs on each pole are generally required in all circuits; those at the generating stations must be set for the normal current in the circuit protected, not for the maximum of the station.

For overhead lines, copper wires of less than ·12 in. diameter are not allowed, and the factor of safety at — 20° C. is to be at least 5, reckoning the *weight* of the wire only. Wooden poles are allowed, of specified minimum dimensions, and the spans are also limited. High pressure aerial lines are not to be stranded or covered; their lowest point must be 20 ft. above ground, and 26·5 ft. in crossing roads. Clear notices warning the public of danger must be displayed, and the posts and insulators are to be painted red. Armoured cables may be placed direct in the ground; unarmoured cables must be protected by conduits, but the neutral conductors of D.C. systems may be laid bare and unprotected. The regulations are especially explicit and profuse in regard to crossings of different lines, crossing railways and roads; for railway crossings, high pressure lines must be carried on metal pillars, not on wood posts, placed as close to the railway line as possible.

Germany.—The Imperial authorities at present do not directly control electrical power systems; the Institute of German Electrical Engineers issues a set of advisory rules, but there are no compulsory regulations. These rules are generally similar to the Swiss regulations, but are rather more stringent; they prescribe tests which must be complied with. The maximum temperature of apparatus is fixed at 50° C. above the atmosphere.

France.—The Government exercises a very direct control over power supply, and has issued a complete set of administrative and technical regulations. High-pressure installations are defined as

those using a pressure above 600 volts D.C., or 120 volts A.C. The span of aerial conductors is limited to 330 ft. Fences are to be fixed to poles at a height of 6·6 ft. from the ground to prevent the public from reaching the conductors. Guards are generally required beneath the conductors where they cross other wires, or roads, rivers and canals. A minimum insulation resistance of 3·1 megohms per mile is specified for aerial conductors; that of every section of an underground line, in ohms, must not be less than five times the square of the potential difference between the conductors.

United States of America. — No general regulations are in force. The National Board of Fire Underwriters has issued a code of safety regulations which are generally accepted. Most of these are covered by the Swiss regulations, and the variations are unimportant.

It is very noteworthy that in all these countries there is no statutory or official regulation as to the maximum voltage that may be used, the maximum power that may be carried by one cable, or by one sub-station, or as to the thickness of the dielectric in underground cables. These are the very features which are unfortunately present in our existing regulations, and the repeal of which is urgently necessary for the success of electrical power distribution on commercial lines in this country.

EFFICIENCY OF POWER STATIONS.

Mr. Philip Dawson's article on "Power Station Efficiency" in *Traction and Transmission* must hardly be taken as a guide. It may serve as presenting a high aim, but it is scarcely safe to accept it as marking actual achievement, for we fear the figures are academic rather than practical, and, as is usual with tramway statistics, the most essential figures are omitted, though we feel sure, from his preliminary remarks, that the author appreciates the facts of his subject, even while talking round it.

With all that he says of the nature of the load curve we fairly agree, but we set small value on, say, Table No. I., which gives particulars of traction stations without remark. Take, for example, Oldham and Ashton, with three 500-H.P. engines and three 300-H.P generators, to drive a paltry 30 cars and 8 trailers. Not over 15 cars are likely to be the average load, and they will not require over 90 KW. The load factor will be about 25 per cent., and the maximum instantaneous output 360 KW., demanding a generator of at most 250 KW. Yet here we find three 300-KW. generators, and no explanation of the fact. If designed for 30 cars, then the station has been very extravagantly put together. Mere tables of data are useless without a further knowledge of the sub-division, or otherwise, of the distribution system on which the power factor depends.

In Table IV. are given some useful actual results of steam engines on traction work which may be taken as fairly good, but Table V., which gives the steam consumption of different engines, is simply a series of steady load results, and is useless for traction purposes. Indeed, no reliance should be placed on steady load steam tests, except as a guide in estimating the economy that might be secured by the adoption, say, of an accumulator. Nor can Table VI. be accepted as of any value for ordinary conditions. We are strong believers in superheat, for it attacks the worst loss of a steam engine at its very outset, but we would hesitate to indiscriminately adopt excessive superheat of the Schmidt type, even with Continental example to go by. The engineers of the Continent tend rather to adopt means to economy of running, with less regard to ultimate economy than is paid by English engineers. At the same time the cost of fuel in Switzerland will justify a higher superheat than would pay in Newcastle.

In this country, with tramway station work, it can hardly fail to pay to adopt condensing, even when water coolers must be employed. Feed heating is another certain economy, and moderate superheat of say 100° is a third. Minor economies must be adopted or rejected as each case may demand. Water purification should always be a possible economy, and so under favourable conditions should a private water supply as compared with supplies at 6d., 8d. or even 1s. per thousand gallons.

Covered steam pipes save more than mere heat, they prevent excessive wetness of steam. All these are economies of existing plant. Accumulators are an economy due to the electrical system. It is possible that by their use other economies might be rejected as now of less value.

These points are hardly touched on in the article before us. Table IX. professes to give the mechanical efficiency of first-class American Corliss engines for railway work. It is given as 60 to 80 per cent. for ¼ load, up to 95 per cent. for full load.

Our author advocates electrically-driven auxiliaries, which only require 3 per cent. of the total power of a large station. This is as it may be. Steam auxiliaries may require even 15 per cent., but how is it when much under-loaded main engines are at work? Other tables give efficiencies of polyphase generators, stationary transformers, and of accumulators over a series of years, showing a diminishing efficiency as a warning of what to expect.

The article closes with some well-chosen remarks on the amount of the copper in the distribution system, and generally on the relation of running plant load factor and capital expenditure. The chief object of a tramway power station and mains is to manufacture electrical units at a minimum cost at the car. Thus both the station and the mains form part of the whole plant to be considered.

There is a great paucity of reliable statistics as to tramways. Mere lists of equipment are absolutely useless to intending designers. Practically nothing is ever published that gives real information. Tables of installed plant are worse than useless because they serve, perhaps, to show what some eminent engineer has put down as necessary, but they do not show whether the plant is well or ill proportioned to the actual requirements.

How much is known of the wear and tear of cars? Who can give reliable approximations to the mileage of the many details of a car, whereby alone any true estimate can be formed of the real value of such articles as trolley wheels, brake shoes, wheels, or axles? Electrical tramways require to organise their statistics more along the lines followed by the steam railways, which can give close approximations to the mileage run by a cranked axle, for example; if a certain class of axle begins to fail its mileage is known, and other axles can be specially watched as they approach the critical mileage.

American practice has been so much followed by tramways that we find cast-iron wheels nearly universal, though English conditions are so very different. A cast-iron wheel may be good enough in America on a raised rail, and it may be durable, but the same wheel run on a narrow-grooved English level rail with tough steel frost nails in the rail grooves may prove far more costly than the more expensive steel-tired wheel. But there are no statistics to help the tramway man to come to a decision on this point. He only finds by bitter experience how absolutely inapplicable American experience proves. Anything with a flange will run on a raised rail, and American practice seems to pay scant attention to forms of flanges. These and many similar points are in urgent need of elucidation and common action.

LESSONS FROM BRITISH LABOUR.

It is not very satisfactory to read Mr. F. Brocklehurst's article in the *Engineering Magazine*. Mr. Brocklehurst gives all possible credit to the Amalgamated Society of Engineers, but it appears that all the causes on which big strikes were fought have been bad causes—that is, they have failed of being successful. Thus, in 1896 there was a strike against a non-union man. Yet to-day the principle of free employment is recognised.

Overtime, piecework, apprentices, control of machinery, have all formed the bases for quarrels, and after half a century of struggles the Amalgamated Society have had to acknowledge defeat all round. When a powerful society thus fails to attain any of its ends one instinctively seeks the reason. Great movements have usually secured something. The Corn Law agitation is a case in point. A great principle was at stake. The movement was headed by men of intelligence, and success followed, and though to-day there are those who sigh for the flesh-pots of Egypt in the shape of Protection, we cannot at this moment call to mind any industry said to be pushed by foreign competition that does not owe any trouble it may be in to its own management or to causes inside these islands. No matter whether we take bridges, locomotives, machine tools or electrical machinery, we can trace all loss of business either to the foibles of so-called Westminster engineers, to the neglect of modern shop methods, or to bad and meddlesome legislation.

Take the great movement whose supporters were known as Chartists. The Chartists were men of foresight, and were rather severely handled by the authorities of their day. One of them was that great free trader, who afterwards became Sir Henry Parkes, Premier of New South Wales. His policy of free trade has at last placed Sydney ahead of Melbourne in population. Ten years ago the difference was large, 20 years ago Melbourne was about twice the size of Sydney. Parkes was a Chartist, and practically left England under pressure. Of all the articles of the Charter, there are only two that are not law to-day. Why? Because they were drawn up by men who had intelligence. Now the policy of the A.S.E. has been unsteady and inconsistent. Its members, as we all know, are constantly striving to work a lot of overtime. Yet the Society has as constantly set itself in opposition to overtime.

The Jubilee souvenir of the A.S.E. itself records the disastrous opposition to piecework. The dispute of 1852 "fizzled out." The strike of 1899 at the Maxim-Nordenfelt works at Erith was a dead failure, and yet it was beautifully arranged for success. On the machine question the A.S.E. are beaten, though we hear from time to time of places where they try to enforce their false ideals. As Mr. Brocklehurst says, the A.S.E. only invite disaster by pursuing a course that is absolutely counter to the true principles of economy. We believe that Britain's natural advantages are so great that had the A.S.E. been intelligently handled, it might have made itself an instrument of immense service to its members and the country at large. It might have seen to it that its members were the very *élite* of the British workmen, that admission to its ranks was a credential only to be stated to secure a job. It might have compelled employers to modernise their shops, and it might have very reasonably instituted a strike against worn out and antiquated tools, and generally been a power for good that would have placed our English shops an easy first in the world on a seven hours' day.

But the A.S.E. has always gone the wrong way, and no good has accrued to either its members or the country at large. It is really

pitiable to think that the policy pursued has resulted in the engineering workmen only receiving two-thirds the pay they ought to have been getting now, and in helping the unprogressive employers to keep a scrap heap of old machines trying to do modern work cheaply. It is even yet not too late to mend. The A.S.E. may still try to educate its members, to weed out the incompetent, and classify them by their ability. If all men tried to work to the best of their ability, the poorest man could still be afforded better pay than the average man of to-day.

ELECTRIC EQUIPMENT OF CRANES.

By WILL. RUNG, of Baden, Switzerland. (Translated by W. PARK and J. LEHMANN.)

THE great improvements that have taken place during the past few years in the generation and transmission of power by electricity have led to the gradual introduction of the electric motor into the workshop and factory. The electric motor shows a high efficiency, runs noiselessly, requires little attention, and occupies a very small amount of space. It is therefore not surprising that in many instances the old and complicated system of power distribution by means of shafts, gear-wheels, pulleys and belts has largely been replaced by a few small motors suitably placed and fed by cables carried unseen throughout the works. As a means of driving both small and large machinery, the electric motor is becoming more popular every year. It has proved itself particularly suited for operating cranes, and it would be scarcely possible to find a motive power allowing of easier and simpler manipulation. By means of a couple of handles the man in charge is able to effect any movement required, and the control of the crane can, without risk or inconvenience, be left to an inexperienced person. The numerous pipes and valves necessary in the case of hydraulic cranes, which often require difficult and tedious repairs, are entirely dispensed with, and the energy supplied through a couple of copper wires, requiring no attention, and causing only trifling losses of energy even when their length is considerable. In this article we shall deal with the various types of motor applicable to crane work, having reference also to the nature of the supply current. We shall also consider what is to the designer the most troublesome matter of all, namely, the controlling gear.

As regards the nature of the current most suitable, the choice lies between continuous and polyphase. The single-phase alternating current does not demand attention, owing to the motors not being readily started. This choice will naturally be influenced by existing circumstances. Should supply mains be already available, the nature of the current supplied will, of course, determine the character of the motor. But if special plant is to be erected, continuous current will, as a rule, commend itself if the installation is a small one, and three-phase current if a large one. Continuous current affords the advantage of enabling a storage battery to be put in parallel with the dynamos, so minimising the great variation of load on the generators, which usually occurs in the electric running of cranes. On the other hand, the adoption of three-phase current reduces the capital cost of plant, increases the security of running and lowers the losses of energy in the leads, especially in the case of a network of some extent. Where motors are used for running machinery in factories, the three-phase current is always to be recommended, as the three-phase motor requires far less attention and is better able to stand rough treatment than the direct current motor. Before finally deciding on the current to be used, the performance of the various types of motors must first have our attention.

THE MOTORS.

The *series motor* is admirably suited for running cranes. It has a very great starting power and starts smoothly; it lifts a heavy load slowly and a light one quickly; it is easily controlled and can endure a severe overload; it also lends itself excellently to be used as an electric brake; yet it is unfit for use on cranes where the load may be zero, as in this case, owing to the small amount of current consumed by the motor, the magnetisation of the poles is very feeble, resulting in an excessive speed which may become dangerous.

The *shunt motor* does not possess so great a starting torque as the series motor, unless its shunt is provided with a regulating resistance. It is mainly employed in cases where a constant speed is required. When lowering a load the motor acts as a dynamo and supplies energy to the mains, and so it cannot exceed its normal speed. The shunt motor certainly can be made equally suitable for working a crane as the series motor by regulating the shunt, but for this purpose a fairly complicated starting and controlling switch is unavoidable.

The *compound motor* is very seldom met with for running crane or similar machinery, though from time to time it has been adopted in America for running lifts.

The *three-phase motor* has gradually become a very serious rival to the direct current motor, and, indeed, is even superior to this in certain respects. Its starting power can, by careful design, be made as great or even greater than the series motor. It requires only a plain starting and reversing switch, and a descending load causes it to act as a brake and send the current back to the mains; its speed can never exceed its normal value, and it always tends to keep up this speed, whereas the series motor tends to produce a constant power. In mechanical respects it is highly superior to the direct current motor, since it has no commutator, and thus works absolutely sparklessly. It requires but very slight attention, and is generally capable of working under the most unfavourable circumstances. At the Millennium Exhibition in Buda-Pesth a three-phase motor was running entirely immersed in water.* As to its susceptibility to control it is somewhat inferior to the series motor, a matter of but small importance in the case of crane machinery.

The *monophase alternating motor* is sometimes employed in cases where a monophase alternating supply has been available, but as a rule the direct use of monophase current is limited to cranes in which but one motor is used to effect the various movements. The motor is bound to be started unloaded, and must be kept running all day long without stopping. In cases, however, where monophase current is available, it will be the best plan to transform it into direct current or three-phase current by means of a synchronous motor-generator.

When designing and fixing upon the dimensions of the motor, special regard must be paid to its future working conditions. As a crane motor is not working all day long without interruption, and, moreover, when working is subjected to varying loads, its dimensions can be made smaller than those of a motor supplying hour after hour nearly the same power. Keeping in view the frequent starting of the motor, a satisfactory starting torque is of great importance, and usually this is obtained at the expense of the efficiency. Besides this, matters must be arranged so as to ensure smooth starting with a moderate amount of current, and furthermore, care must be taken that the motor, when switched off, stops as quickly as possible. This desideratum is best complied with by giving the armature a small moment of inertia, and a low speed must be used—or, in short, the motor must be multipolar. This arrangement, however, necessarily increases the weight and volume of the motor, and internal resistance of the armature, all resulting in an increased variation in speed from light to full load. In the case of a 50-H.P. motor making 550 revolutions, the weight of the armature amounted to about 500 kilogrammes, the diameter being 36 cms.; another 50-H.P. motor, making 200 revolutions only, had an armature weighing 800 kilogrammes, with a diameter of 56 cms. Upon calculating the moments of inertia of these two armatures, the fast running one was found to require 2·9 times as much power at the start as the slower one; on the other hand, a 4-H.P. motor making 950 revolutions showed a reduction in the number of revolutions from full to lightest load amounting to 4 per cent. only, the same figure for another 4-H.P. motor of 200

* *Vide Zeitschrift vom Verein deutscher Ingenieure*, 1897, p. 839.

revolutions being as great as 15 per cent. This fall of speed, however, is of but little importance in the case of crane motors. As, moreover, the lower speed presents the advantage of simplifying the gear between the motor and the crane hook, thus allowing of a higher efficiency, it follows that it will usually be preferable to keep the speed low.

As above-mentioned, the intermittent running allows of severely overloading the motor for a short time, that is to say, a high induction can be used and the iron and copper sections made smaller than usual. In mechanical respects the motor must be strong and rigid; and care must be taken to provide ample ventilation. In the case of direct-current motors, attention must be paid to prevent sparking at the

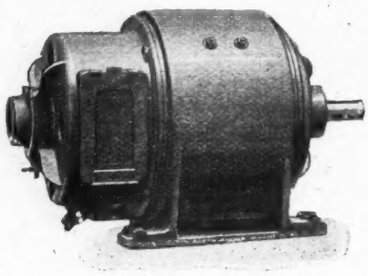


Fig. 1.

commutator in order to avoid the necessity of shifting the brushes when changing the direction of rotation; for this purpose the rate of magnetisation must be high, and carbon brushes must be used.

The windings of the armature as well as the commutator must be well protected against dust and dirt, and all the bearings made self-lubricating.

Fig. 1 gives a view of an enclosed series motor for crane work made by Messrs. Brown, Boveri & Co., Limited.

The three-phase motor must be designed so as to start also with a fairly heavy overload. In order to secure a good starting torque the best arrangement to adopt is to insert the starting resistance into the rotor circuit and not into the stator circuit, as in the latter case the primary tension decreases, and the starting power depends on the square of the tension. Small motors of 4 to 5 H.P. can be made with a squirrel-cage rotor, thus requiring no starting resistance whatever, but this type has a relatively small starting power and starts rather suddenly. Brown, Boveri & Co. build such motors with a rotor of large electric resistance, thus

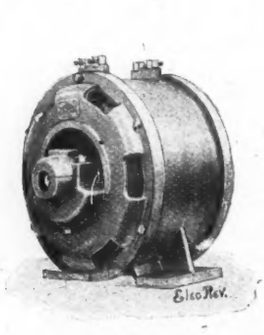


Fig. 2.

substantially increasing the starting power and providing a smooth start. That a three-phase motor may work economically it is of great importance, especially in the case of larger plants including several motors, to prevent the lag between pressure and current being too large; this lag is due to the self-induction of the stator, caused by leakage of lines of force. Some of the lines of force created by the stator winding, instead of passing through the rotor core leak through the air and the thin bridges of iron separating the stator conductors from the air gap. The action of these stray lines of force is to produce another E.M.F., the phase of which is 90° displaced from that of the supply pressure. This makes the current lag a certain angle relatively to the supply pressure. Now, the power given out of the dynamo at any moment equals pressure × current × cosine ϕ, from which it follows that the motor must be so designed as to make cosine ϕ as large as possible. This is usually obtained by opening towards the rotor the slots in which the stator winding is placed, or by forming these slots as close to the inner surface of the stator as possible; this method greatly minimises the leakage, and for a well-designed motor the value of cosine ϕ should not be below 0·9 at normal load. Fig. 2 represents a three-phase motor for running cranes, made by Messrs. Brown, Boveri & Co.

(To be continued.)

CYCLISTS AS STOP-BLOCKS.

By ROBERT N. TWEEDY.

" . . . . the Light Railways Act of 1896 will, in all probability, prove to be a veritable Frankenstein, whose ravages no man can foresee."

After reading that sentence I packed up my belongings preparatory to leaving a country in which unknown horrors might face one at any moment. Better the swift bullet at the front than the quivering suspense while awaiting the unimaginable. However, after the first cold chills of apprehension had passed, it occurred to me that the prophecy might be as unfortunate as the simile, and I sat down to read again the editorial carrying such an ill-favoured tail.

Its heading is "Light Railways," and it takes premier position in a recent number of the *Cyclists' Touring Club Gazette*, the magazine which is posted gratis to 60,000 cylists monthly.

Although an ardent member of the C.T.C.—the club which, among a thousand other things, has done more than any other body to obtain the recognition of the whilom "cad on castors" as a possible person, and to cheapen and facilitate touring—I have had my loyalty shaken several times when reading the embittered articles and editorials aimed at any new traction scheme in particular, and all road-rail traction in general.

Nor has the club stopped at ink slinging. It has persistently blocked new schemes and extensions in Parliament, but with small success.

The efforts of the club would meet with nothing but sympathy if they were brought to bear solely on those matters which touch closely all cyclists; efforts, that is to say, to obtain guarantees that reasonable widenings shall be made, and that the road which light railways are to pass shall be well made and well maintained. But when these efforts are supplemented and practically smothered by malignant and wholly impolitic attempts to quash the already over-delayed progress of quick and regular road travelling and transportation, then it is time that counter-action be taken.

The editor of the *Gazette* would say, probably, that the efforts of the club *have* been confined within legitimate bounds, but such a statement could be contradicted easily.

One only has to quote from the current editorial to uphold the contradiction. It begins by stating that the Light Railways Act of 1896 was passed ostensibly for the benefit of the rural districts, that it has been a failure from this point of view, but that advantage of the provisions of the Act has been taken "by company promoters, corporations, and district councils, to extend to an alarming degree, upon conditions far less onerous than the Tramways Act imposes upon them, the urban tramway system, until it seems probable that all the more populous counties will presently be intersected by a network of tramways—yclept light railways—laid upon the public roads. And, *what is worse* (our italics), the present Government stand pledged to an extension of this undesirable feature, for in the Light Railways Bill, which is before the

House . . . . . provision is made whereby 'an order under the principal Act (1896) may authorise the making of a light railway on *any* highway.' "

How can we reconcile this direct denunciation of all tramways with the paragraph immediately following: "It would, of course, be in the highest degree impolitic of the cyclist to object to tramways and light railways as such, and in cases where a majority of the inhabitants of any district are in favour of some tramway scheme that may be submitted to them, the utmost that he can reasonably urge is that due regard shall be paid to the interests of other road users—cyclists included. To this end a minimum width may well be stipulated for; the proper upkeep of the surface insisted upon; . . . ."

The whole question is one of utility. The representatives of the cyclists should recognise that their most valiant efforts will not set back the tide which the *people* are urging forward, not, as these followers of Canute and Mrs. Partington imagine, in order to swamp them and their cycles, but to ameliorate their own conditions of life; to enable them at the smallest expense to transport themselves and their merchandise from the country to the market; to waft the townstewed to health and pleasure in the country; and to interlink streets and houses.

There are more than a few cyclists in London, but it is well to remember that a few miles of line running into the country from Shepherd's Bush carried 300,000 passengers on one day of the Whitsun holidays.

As the law exists at present, it rests with the County and Town Councils and the Light Railway Commissioners to impose road widenings, or a part cost of them, on any company building a line; and track maintenance for 18 in. beyond the rails on each side is provided for in all orders. How many instances one could cite, in which the laying of a tramway has been the first step towards the betterment of the remainder of the road!

It is very noticeable that heavy traffic will take invariably to the track when that is laid with trimmed setts, and the rest of the road is macadamised. In many cases the track is preferred by cyclists, only as the lesser of two evils however; for no reasonable creature would ride on setts if there were a better surface just alongside.

All this goes to show that the Cyclists' Touring Club is hitting the wrong dog when it lashes at such public boons as tramways—yclept light railways—and it might do less disservice to the public if it directed a few blows at those whose duty it is to maintain in rideable condition those portions of the road unoccupied by the instruments of Frankenstein.

Compared with the Tramways Act of 1870, the probationary Light Railways Act of 1896 has been the Magna Charta of tramway promoters, but it is still an imperfect instrument, and it behoves all interested to use their best efforts to obtain a greater measure of freedom in the renewal of the Act.

DANGERS FROM TROLLEY WIRES AND THEIR PREVENTION.

Prof. Jamieson has chosen a fitting time to read his paper with the above title. It is well that the public should be reassured after the late scares, arising in chief from the sad accident at Liverpool and its milder successors. This paper shows clearly and simply that, if the proper precautions are taken, serious accidents need not occur through the breakage of an overhead wire of any sort.

There are three distinct dangers to be apprehended:—

1. The falling of a message wire across a trolley wire.
2. The falling of a guard wire.
3. The falling of the trolley wire itself.

Either of the first two occurrences, under conditions which should never be permitted in modern practice, may bring about one or both of the others.

Many kinds of guards have been tried, and more have been suggested to overcome the first two, but not till recently, so far as we know, have any practical safeguards been put forward or adopted to deal with the third incident.

Prof. Jamieson deals first with the methods which have been adopted for protection against contacts with trolley wires, and condemns the wood strip used in Liverpool—and, we fear, in other towns—both in words and by more suggestive illustrations.

There are those who think that this absurd "guard" was not criticised severely enough after the Liverpool fatalities. Mere criticism in any case would have been too mild; it should have been condemned outright. Like the notorious Belleville, any engineer might have condemned it from the drawings.

While the paper was being prepared an illustrated description of the guard-strip now being adopted at Liverpool was received. So far as we can see, this arrangement differs in nothing but its mode of attachment from its predecessor, and it is left for us to hope that all the overhead wires are removed from the vicinity of the tramways before the winter comes with its snow-storms.

There does seem to be one way in which this Liverpool strip might be made effective, without detracting from its appearance; although, for other reasons, the whole arrangement is considered to be far from perfect.

The suggestion is that copper or galvanised steel wires be stapled along the whole length of the top, and perhaps the sides, the ends being taken to the bracket arms or poles, which must be bonded to the rails (fig. A).

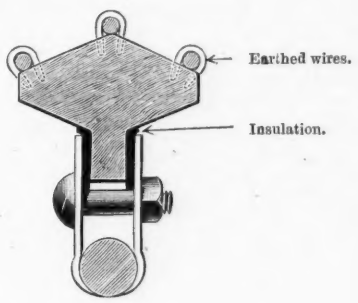


Fig. A.

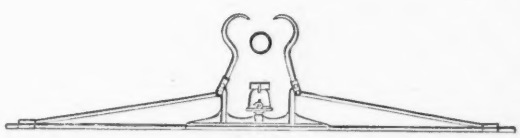


Fig. B.

It is doubtful if the insulation between the earthed wires and the trolley wires could be maintained for any length o. time, even if the strips were made of specially prepared fibre, but the idea suggests the only method by which the guard in name could become one in reality.

The hope expressed above is in a good way to be fulfilled, as the letter mentioned states that arrangements have been made with the National Telephone Company to place all their wires crossing the trolley wires underground by this September; and that a settlement on the same lines has been nearly completed with the postal authorities, who by nature have more inertia than the company they have persecuted.

Of course that is the only real solution of the guarding question. Let all message wires dive below ground when they approach a trolley wire, and their potential danger vanishes as completely as themselves, to the benefit of everyone.

Figs. 2 and 3 in the paper illustrate the usual arrangement of guard wires. We believe that fig. 2 is the most usual arrangement, whether the wires are insulated or not. If insulated they become Liverpool strips in effect, but would hold out of contact with the trolley wires a much larger per-

centage of fallen wires than that strip. As Prof. Jamieson points out, it is very necessary to anticipate wires falling in the most awkward fashion, with a tendency to curl upwards. Therefore, unless a roof is built over the trolley wires, it is conceivable that the most elaborate arrangement of guard wires will not prevent contact being made at some time.

It is most undesirable to put more than two guard wires over any trolley wire, and it is just a question for discussion as to the positions they should have relatively to the live wire.

The G.P.O. requires them to be 8 in. on each side of a single wire, and 8 in. on the outside of two wires not more than 12 in. apart, and we think that this arrangement is superior to that shown in fig. 3. There should be no need nowadays to remark that a wire trying to fall across a live wire should be well earthed during the endeavour, but it is an astonishing fact that on all the principal German tramways the guard wiring is most scrupulously insulated—insulated, practically, as well as the trolley wire. Throughout the greater portion of Berlin, indeed, wood strips, of a more unserviceable type than the Liverpool strip, are in use; but new, and we must suppose improved construction, has one steel wire supported from the hanger caps vertically above each trolley wire, and insulated from earth throughout.

Such a wire, of course, is entirely useless. If a message wire falls, it must inevitably curl or droop on to the trolley wire, ready, then, to electrify or electrocute the unwary. When, however, a proper connection with earth is provided, this particular arrangement is as neat as any we have seen, and, if one could rely upon a single broken message wire fusing directly it short circuited the line, or upon a bunch of wires opening the station, or section, circuit breakers immediately, it would combine efficiency with neatness, although, as we have indicated previously, the maximum efficiency is attained only when fallen wires are held out of contact, neither becoming dangerous nor cutting current off the line.

Guard wires should be earthed at every anchorage, and these points should be fairly frequent, both, as Prof. Jamieson explains, to reduce the resistance of the earth circuit, and to minimise the length of wire which may be pulled down by an errant trolley pole. We have seen guard wire hanging in white-hot festoons, because the earth current was not heavy enough to operate the circuit breaker on the feeder.

Prof. Jamieson is of the opinion that guard wires should be made of silicon bronze, this metal being stronger than galvanised steel for the same size, having greater conductivity, and being better able to withstand corrosion in an acid-laden atmosphere. We would extend this recommendation to trolley span wires, which are made usually of stranded galvanised steel. The galvanising cracks and peels off this wire, especially at the nozzles, unless very great care is used, and the unprotected steel begins to oxidise immediately.

The Post Office in their regulations desire that "In all cases in which telegraph wires and trolley wires are parallel, and within 30 ft. of each other, suitable hooks shall be fixed on the arm-stay or on a span wire," in addition to the ordinary guard wires; and "Where the telegraph lines are so close to the trolley wires as to render the foregoing protection insufficient, the guard wires should be laced." After reading all the regulations, one arrives at the conclusion that the Postal authorities will ascribe any breakage of their lines to Providence, and will cast the whole responsibility for any damage arising through contact with live wires upon the owners of the tramways. On the other hand, we consider that it should devolve on the P.O. to so erect and maintain its lines that breakages shall not occur, and to use such reasonable precautions as to prevent any damage following a break.

Prof. Jamieson says that he is not aware of any place where lacing is introduced. We were once acquainted with a line where it was done, and we have a lively recollection of the trouble it caused. Unless a de-wired trolley-pole tore down the whole construction, the head became so enmeshed, that it was necessary to unship the pole itself in order to free it.

While recognising that, as matters stand now, some form of wire guard is necessary, we can but deplore the necessity, as the experience is universal that guard wires themselves are more often the cause than the preventatives of breakdowns and delay. For instance, the record on one English system shows that during nine months there were 10 breakdowns caused by the guard wires earthing the line, and that no message wires fell during the same period.

In speaking of the breakage of trolley wires, Prof. Jamieson drew attention to the strength of the wire in general use, in order to point out that this wire is not so likely to snap under accidental stress as to wear out at sharp curves. This undoubtedly is true, and with the object of reducing this wear, the wire should be supported at frequent intervals by long and flexible ears, which will take the curves sweetly. German practice, so far as we are acquainted with it, is at fault on this point as well, very short screw-clip ears (4 in. to 5 in. long) being used, which take the curves like polygons. Probably most men who have been connected with lines on which double-deck cars are run, have seen the heavy trolley standard bases broken, or the top roof ripped up, as the result of a trolley head fouling the overhead construction, apparently to the small detriment of the construction itself.

Sec. V. of the paper is devoted to "Freeing, earthing and other safety devices." A section on which any fault has occurred, must be made dead at once, and many automatic devices have been designed to effect this. When the line is quite small, and the power house never has more than, say, a 100-KW. machine per feeder, the circuit breakers in the station can be depended upon generally to look after faults of any sort. When the feeders have considerable power at the back of them, unless the fault be a dead earth, it is possible that the circuit-breakers will not operate. It is good, therefore, to have some device in the section boxes, or on the overhead construction, which will deal immediately, and certainly, with any fault; and there should be arrangements at every section-box for telephoning to the power station.

We think, with the author, that one of the simplest and most effective devices for "deadening" a section is the one which is being tried at Leeds. It consists of a switch, or a plug block, which, when closed, short circuits the line through the trolley pole of the car on which it is fixed. There is nothing automatic or delicate about this, and it is always at hand on anything like a frequent service; but we would suggest that a specially fitted device is rather unnecessary, as most car controllers afford the means of earthing the line by cutting out both motors and turning the handle. Perhaps the car circuit breaker might object though, as it would have to be held in.

Fig. B shows Blackwell's neat and simple earthing device, which does not involve solenoids, and other complications.

Whether safety devices are installed or not—at present they are the exception—instructions to motormen as to the action to be taken when a broken wire is encountered should be explicit, and should differentiate between hanging and trailing wires, and between wires falling in thickly and in sparsely populated portions of the road.

In a busy town the wire should be taken to the rail and held there by the foot, but in the country it might be quite allowable to secure the wire temporarily in a position such that earth is not made, and in which it does not foul passing cars. A man should be detailed to watch the place till the linemen arrived.

If a trolley wire falls during wet weather it may make good enough earth to open the circuit breakers, but in very dry weather, if it falls clear of the rails, it is probable that the leakage will be comparatively minute. We have seen 30 yards of live wire lying along the road and cars running quite unconcernedly on the sound wire.

With regard to the possibility of a live wire falling on a double-decked car, we must confess to feeling very uncomfortable at the thought of it. Prof. Jamieson does not touch on this point. The danger is very real, as the distance through which the wire has to fall is but a few feet, and one cannot rely on the wire striking the earthed railings.

Although the cars would be rendered more unsightly thereby, the most effective protection would be a light roof, or a stout network of wire which would be connected to the truck. On most lines it would hardly be possible to allow sufficient headroom for a passenger in an upright position, but complete immunity from danger would be obtained without relying on automatic contrivances.

A TIMELY PROTEST.

We have been sent a copy of the following letter, which has been addressed to the *Birmingham Daily Mail*, in reply to the paragraph which it quotes from a recent issue of that paper, and which it will be seen suggests "a grave reflection" on the British electrical profession. As our readers are well aware, the interests of home electrical manufactures have our constant attention and support, and we have expressed ourselves freely concerning the senseless restrictions which have hampered the natural development of the industry in this country. We have no desire to undervalue the great efforts, worthy of all praise, which have been made by our British electrical engineers to maintain their position in the face of such restrictions, but with paragraphs of this sort continually appearing in the daily press, there is no advantage in attempting to keep silent, or to avoid full and open discussion of the causes which are responsible.

The defence of "An English Electrical Engineer" reads as follows:—

The first paragraph in your "Notes and News" of the 23rd inst. reads as follows:—

"The latest Yankee report is that a New York firm has been given the order to supply the electrical machinery for three elevators for Buckingham Palace. . . . If it be true, the reflection on English electrical engineers is very grave indeed."

You say that the report lacks confirmation, but there is no *primâ facie* reason to doubt its substantial accuracy, or that the department responsible for placing the order was not actuated solely by the desire to obtain the best article on the most favourable terms.

The serious point of the paragraph is that an influential journal, circulating in one of our greatest manufacturing districts, should see in such a circumstance a very grave reflection upon English electrical engineers, and in justice to members of the profession who, under most disheartening circumstances, are endeavouring to maintain the position of this country in the great industry of the new century, I trust you will afford me space to describe the chief initial causes, as we believe, for vast orders for electrical machinery and accessories being sent abroad.

When the practical uses of electricity first became notable, British engineers took a prominent part in developing the new industry, and British capital was readily forthcoming. They would be leading the world still if they had been given fair play. But the curious commercial policy of this country, which attempts to combine external free trade with internal protection, could not permit any sort of encouragement to the new industry.

At an early stage Parliament "rose" to the occasion, and made haste to arm municipal councillors against the efforts of personal enterprise to spread the benefits of electricity. The Tramways Act, 1870, made it impossible for some years to provide mechanical means of locomotion in the streets without losing nearly all the capital involved. Then came the Electric Lighting Act of 1882, which struck an equally damaging blow at those iniquitous people who were eager for the progress of general electric supply.

Parliament refused to consider the interests of those who were ready and able to provide what we now recognise to be a necessity of industrial life, and Parliament ignored also the interests of manufacturers who might otherwise have had electric power years ago, and thus kept abreast of competitors fortunately situated in countries whose Legislatures have been consistently sympathetic towards the electrical industry. Parliament, in fact, shirked the treatment of electricity as a national question, and threw its responsibility on the shoulders of local councils, giving to them the fatal power of veto.

In many cases these local rulers were directors of gas companies; in others the town itself owned gasworks, and when the electrical engineer came along the gates were shut in his face. These things are happening even now in the twentieth century, although Parliament has, in a pottering way, modified the crude ineptitude of the earlier Acts, and the general consequence is that our manufacturers have been handicapped by the absence of cheap power, while the electrical industry has been seriously checked in its growth by the fact of there having been until recently a very limited home market for electrical machinery.

You cannot develop such an industry without a steady home demand. The reason why such great quantities of electrical machinery are being imported, made by American and German instead of British labour, is because they have learned for years back by constant practice in a brisk home trade to make these things more cheaply than we can. How can it, then, be fairly said that "the reflection on English electrical engineers is very grave indeed"?

The reflection is on the foresight of the English Legislature and the ignorance of the British public. The engineer has been expected to fight with one hand tied behind his back, and with several ponderous Acts of Parliament hung round his neck.

The truth is that electrical progress in England has been the unfortunate victim of a wave of diluted socialism. Our policy as a nation in the past has been to encourage personal enterprise. All the greatest public works of the Victorian era, including railways, canals, harbours, steamship services, and the like were certainly initiated, and, in most cases, are still carried on by the flower of the nation's capital and labour animated by individual endeavour. Like everything else, the system has its faults, but, on the whole, it has served England well.

Electricity, however, has been sacrificed on the altar of socialism, and the result of 20 years of oppression is picturesquely summed up in the two reports that the King of England's Palace is being fitted with American electrical lifts, while the Queen is issuing an appeal to the ladies of the aristocracy to wear British materials at the Coronation.

What special advantage is it to England and our working men that capital should be invested in Argentine Cedulas, American breweries, and the like rather than in the development of British manufacture, one is unable to perceive. It certainly seems anomalous that while the United States railways were being constructed with many millions of British capital, our own Government was carefully legislating in such a manner as to warn off capital from English tramway enterprise. That America is such a powerful industrial competitor to-day is largely owing to the assistance of capital which was unable to find remunerative employment in England.

In such an International struggle, heaven help us if we are to rely on aldermen and councillors as our champions. In the hour of trial most of us will probably prefer to be on the side of the representatives of individual enterprise, practical science, and profit-seeking labour than on that of the miscellaneous crowd of property jobbers and their satellites so largely represented in the government of our towns, and some of whom, while responsible for the existence of some of the foulest slums in Christendom, are endeavouring to hamper comprehensive electric power and traction projects by means of which the evils of congestion can be most effectually destroyed.

While defending electrical engineers, the writer refers incidentally to the hard case of the working man, who, after all, is the greatest sufferer by any policy which tends to check free industrial development. The most deplorable aspect of the question, indeed, is that the working man is being cozened into the belief that municipal trading opens up a royal road to the Millennium, and in the meantime increases direct employment and raises wages. It cannot be denied, as "An English Electrical Engineer" strongly hints, that a large proportion of the members of local authorities consists of "property jobbers," and others whose private interests are opposed to real progress, especially when it takes the shape of comprehensive schemes of electric traction and power supply through town and country, which automatically reduce the value of slum property, and at the same time reduce the income of those who have fattened on the necessities and the sufferings of the overcrowded poor. Nowhere are fortunes made more rapidly than in such neighbourhoods by the publicans, tradesmen, "estate agents," brokers and undertakers, who prey upon this herded humanity. And when we reflect how much might have been done in the past 20 years to put an end to these horrors if only electrical science had been given a free hand, we are not disposed to rebuke the indignant tone adopted by "An English Electrical Engineer" in answer to the "indictment" of a misinformed daily paper.

As we noted in our last issue, the report that a New York company is to make the electrical machinery for three elevators for Buckingham Palace is not quite accurate. The Otis Elevator Company, while due, we believe, to American initiative, is domiciled here.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

16,615. "Improvements in or relating to controlling apparatus for electric motors." A. J. Boult. (N. A. Christensen, United States.) August 19th. (Complete.)

16,628. "Improvements in mercury or other interrupters for use with induction coils." H. C. Newton. August 19th.

16,651. "Improvements in secondary batteries." V. Jeanty. August 19th.

16,653. "Improvements in the manufacture of filaments for incandescing electric lamps, and in apparatus for use in such manufacture." W. L. Voelker. August 19th.

16,670. "Improvements in electrical indicators." J. W. Manley. August 19th. (Complete.)

16,677. "Improvements relating to the manufacture of electrodes for galvanic batteries." R. Pörscke. August 20th. (Complete.)

16,707. "Improvements in means for transmitting and receiving musical sounds electrically applicable to harmonic telegraphy or telephony." A. T. M. Johnson and G. Guyott. August 20th.

16,710. "Improvements in electrical switches." H. W. Cox. August 20th.

16,712. "Improvements in or relating to automatic apparatus for controlling the speed of tramcars, automobiles, and other electrically or mechanically propelled vehicles." H. E. Yerbury and the firm of Estler Bros. August 20th.

16,759. "An improvement in electric arc lamps." C. E. Foster. August 21st.

16,762. "Improvements in and connected with electric switches." H. O. Farrell. August 21st.

16,766. "Improvements in armatures for dynamos, motors, and like machines." H. Newton. August 21st.

16,767. "Improvements connected with the switch points of overhead electrical traction conductors." W. E. Rowlands. August 21st.

16,783. "Improvements in the mode or method of reproducing at a distant place or places, scenes, events or the like, occurring at the time of transmission by the aid of electricity." R. R. Harper and L. Franckel. August 21st.

16,810. "A new or improved relay and methods of employing the same in connection with multiplex telegraphy, telephone systems and the like." P. O. Pedersen. August 21st.

16,814. "Improved means applicable for use with overhead electric conductors for the prevention of danger in the case of telephone, telegraph or other wires falling across them." R. P. Wilson. August 21st.

16,827. "Improvements in apparatus for the electric ignition of the charges in internal combustion engines." J. Edmondson. August 22nd.

16,847. "A new or improved cord grip for electric pendant lamps." R. O. Wright. August 22nd.

16,874. "Improvements in electrolytic apparatus for production of chlorine and alkali." J. Mactear. August 22nd. (Complete.)

16,898. "Railway signalling on engines and in cabins; contacts, mechanical, electric or pneumatic." G. Spurgeon. August 22nd.

16,902. "Electric typewriter." W. H. Wheatley. (The Electric Typewriter Company, United States.) August 22nd. (Complete.)

16,911. "An improved plug and socket detachable switch for electrical connections." F. W. Heaton and H. Smith. August 23rd.

16,913. "Electric field surprise target." C. Mitchell-Innes. August 23rd.

16,941. "Improvements in and relating to electric arc lamps." L. B. Codd. August 23rd.

16,950. "Improvements in and relating to electric switches and to combinations of the same with wall plugs and the like." T. H. Marsh and O. D. Lucas. August 23rd.

16,955. "Improvements in and relating to electrical inter-communication." A. V. Wagenen. August 23rd. (Complete.)

16,979. "An improved electric cut-out." W. J. Davis and A. E. Palmer. August 23rd.

17,023. "Improvements in alternating electric current transformers." H. M. Hobart. August 24th.

17,024. "Improvements in insulating material for electric apparatus." The British Thomson-Houston Company, Limited. (W. C. Fish, United States.) August 24th. (Complete.)

17,025. "Improvements in systems of electrical distribution." The British Thomson-Houston Company, Limited. (A. D. Lunt, United States.) August 24th. (Complete.)

17,026. "Improvements in electric circuit breakers." The British Thomson-Houston Company, Limited. (E. M. Hewlett, United States.) August 24th. (Complete.)

17,027. "Improvements in locks for electric motor controller handles," The British Thomson-Houston Company, Limited. (J. B. Linn, United States.) August 24th. (Complete.)

17,028. "Improvements in electric brake systems." The British Thomson-Houston Company, Limited. (C. E. Barry, United States.) August 24th. Complete.)

17,029. "Improvements in lightning arresters." The British Thomson-Houston Company, Limited. (H. R. Sargent, United States.) August 24th. Complete.)

17,030. "Improvements in electric insulating material." The British Thomson-Houston Company, Limited. (W. Le R. Emmet, United States.) August 24th. (Complete.)

17,031. "Improvements in automatic clutches." The British Thomson-Houston Company, Limited. (A. R. Everest, United States.) August 24th. Complete.)

17,039. "Improvements in or relating to rifle range telephones." C. R. Crosse. August 24th.

17,045. "Improvements in driving gear for dynamos." O. Böhm. August 24th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1899.

23,290. "Improvements in regulating rotary electric converters." The British Thomson-Houston Company, Limited. (E. J. Berg.) Dated November 22nd, 1899. Rotary converters are regulated by varying the inductance or reactance on the alternating current side in accordance with the load. The specification describes an arrangement for maintaining a constant direct current voltage. 14 claims.

23,291. "Improvements in systems of electrical distribution." The British Thomson-Houston Company, Limited. (C. P. Steinmetz.) Dated November 22nd, 1899. Relates to means for compensating for the drop of potential at distant points in alternating current systems of distribution, and consists in connecting with the circuit a phase advancing device or source of leading electromotive force. The specification describes a three-wire system in which over-excited synchronous motors are provided at sub-stations to produce the desired rise of potential. 9 claims.

23,292. "Improvements in electric locomotives or motor cars for adhesion and rack railways." The British Thomson-Houston Company, Limited. (The Union Elecktricitats Gesellschaft.) Dated November 22nd, 1899. Relates to an arrangement of electro-motors for vehicles running either by adhesion alone or by a combination of adhesion and rack rails. Two motors of different capacity are used. The weaker motor drives the adhesion wheels and axle as usual, and the stronger motor drives the adhesion wheels or the cog wheels engaging the rack or both as desired through gearing and a clutch. 1 claim.

23,315. "Improvements in and connected with electrolytic meters." A. Wright. Dated November 22nd, 1899. An electrolytic measuring cell of any kind is shunted by a definite resistance so that only a fraction of the main current passes through the cell, and the back electromotive force of this cell is balanced by a primary or secondary galvanic cell, a thermopile heated electrically or otherwise, or other source of electromotive force, connected in series with it. 3 claims.

23,316. "Improvements in and connected with electrolytic meters" A. Wright. Dated November 22nd, 1899. An electrolytic measuring cell of any kind is connected across a main resistance and a part of a second resistance placed between the mains so that the electromotive force derived from the second resistance balances the back electromotive force of the electrolytic cell, and a definite fraction of the main current passes through the cell.

23,318. "Improvements in electrodes for medical application of electricity." R. Houghton. Dated November 22nd, 1899. Electrodes for therapeutic purposes are made hollow so that hot water or other heating material can be introduced therein. 3 claims.

23,319. "Improvements in electrical measuring instruments." L. B. Atkinson Dated November 22nd, 1899. Relates to current meters described in the Electrical Review for June 14th, 1901. 3 claims.

23,371. "Improvements relating to switches, specially applicable to switches for electromotors and the like." R. A. Sloan and J. E. L. Barnes. Dated November 23rd, 1899. Relates to motor switches in which the main and regulating switches interlock such as described in Specification No. 1,044, A.D. 1899. 9 claims.

23,403. "Improvements in and relating to electric igniting apparatus useful for lighting cigars or for similar purposes." H. H. Lake. (S. Abbott.) Dated November 23rd, 1899. Relates to electric igniting apparatus for lighting cigars and for similar purposes, and consists in the combination of a magneto-machine sparking device and torch, which when lighted can be removed from the machine. 8 claims.

23,413. "Improvements in the construction of dynamo-electric machines." M. H. Robinson and M. H. P. R. Sankey. Dated November 23rd, 1899. In a dynamo in which the armature or revolving part is coupled directly to the engine fly-wheel, the ordinary dynamo shaft is dispensed with and the spider or boss is cast with a prolongation forming a journal which runs in the bearing. 1 claim.

23,504. "Improvements in receiving apparatus for Hertzian radiations or electro-magnetic waves." J. C. Saviera. Dated November 24th, 1899. Relates to receiving apparatus for Hertzian, &c., radiations. 6 claims.

23,663. "Armature for alternating current motors." J. Burke. Dated November 27th 1899. An armature for induction motors consists of an iron core provided with notches in which are placed a series of independent closed-circuit conducting elements, each of which embraces two or more teeth. 2 claims.

23,713. "Improvements in or relating to electrically illuminated advertisements or signs." H. Tripp and W. C. C. Wabash. Dated November 28th, 1899. Relates to letters forming advertisements or signs, which are illuminated by electric incandescent lamps. 7 claims.

23,728. "Improved manufacture of lead plates for secondary batteries." M. Wulliot. Dated November 28th, 1899. Lead plates which are to be used in secondary batteries are cleaned and roughened by projecting against them a jet or spray of finely pulverised hard substances such as sand, iron filings, &c. When accumulator plates are provided with thin ribs which are to be bent over to hold the active material in place, the sand blast and the like may be employed to bend the ribs. 2 claims.

23,734. "Improvements in or relating to electric lighting or heating apparatus." J. Bouillet and J. Levallois-Perret. Dated November 28th, 1899. In a motor lamp, horizontal carbons are carried by two pairs of side rollers and two lower rollers. 4 claims.

23,737. "Improvements in pneumatically operated contact shoes for third-rail electric railway systems." British Thomson-Houston Company, Limited. (S. H. Libby.) Dated November 28th, 1899. The shoes are raised and lowered by pneumatic means which may be operated automatically when passing a conductor crossing, &c. 7 claims.

23,738. "Improvements in regulating electric alternators." British Thomson-Houston Company, Limited. (C. P. Steinmetz.) Dated November 28th, 1899. Relates to the regulation of alternating current dynamos for the purpose of obtaining a constant potential, irrespective of any changes in load or in the phase relation between current and electromotive force, and comprises improvements on the invention described in Specification No. 29,585, A.D. 1897. 4 claims.

23,739. "Improvements in electric railway systems and cars." British Thomson-Houston Company. (W. B. Potter.) Dated November 28th, 1899. In addition to the ordinary adhesion driving wheels used on the level, and the gear wheels engaging racks on inclines, secondary wheels are provided to run on rails on the inclines which are placed out of line with the rails on the level. 7 claims.

23,740. "Improvements in controlling alternating electric current motors." British Thomson-Houston Company, Limited. (C. P. Steinmetz.) Dated November 28th, 1899. Relates to a system of controlling alternating current induction motors which obviates the necessity for any special means for extinguishing arcs at the controller contacts. 13 claims.

23,753. "Improvements in maximum electrical current indicators." E. C. Rimington. Dated November 28th, 1899. A maximum current indicator consisting of an electrolytic cell producing gas which escapes through a porous plug of glass wool, or other material, or through a small hole in a metal plate, and a means for registering the highest pressure of gas during any period, this pressure depending on the rate of production of gas by the current. The cell may be used for measuring total quantity. 4 claims.

23,755. "Improvements in electrolytic apparatus." J. D. Darling and C. L. Harrison. Dated November 28th, 1899. Relates to apparatus for decomposing fused electrolytes, such as hydroxides or nitrates if alkaline metals or alkaline-earth metals; in which a porous diaphragm, such as is described in Specification No. 22,236, A.D. 1897 is employed. 6 claims.

23,813. "Improvements in galvanic batteries." Siemens Bros. & Co. (Siemens and Halske Actien-Gesellschaft.) Dated November 29th, 1899. Relates to sealed batteries of Leclanché and other types, and consists in arranging the cell so that the gases generated from the electrolyte are caused to pass through the depolariser on their way to the gas exits, so that none of the liquid escapes, and the gases have also a continual loosening action upon the depolarising mass. 2 claims.

23,829. "Improved system for the generation of electric currents at constant potential." G. Koppelmann. Dated November 29th, 1899. Relates to an improved system for maintaining the potential of generators constant notwithstanding variations in the speed of rotation. 1 claim.

23,830. "Improvements in the process of manufacturing carbons for electrical and electro-chemical and other purposes." E. Pohl. Dated November 29th, 1899. Carbons for electrical and electro-chemical and other purposes are prepared by treating carbon bodies, whilst embedded in a mass of reduced carbon, with a carbon-yielding gas under the action of heat, the gas being conducted from the outside into, or produced within, the enclosing mass of reduced carbon. When a smooth surface is required on the finished carbon, the carbon body to be treated is tightly covered with a thin layer of readily cokeable substance. 2 claims.

23,877. "Improvements in or relating to electric gas lighters." H. de Thiersant and H. J. Norballe. Dated November 30th, 1899. The gas cock, which is electrically actuated, is formed with an axial hole and three series of radial holes. 5 claims.

23,919. "Improvements in or relating to type printing telegraphs." J. Stockert. Dated November 30th, 1899. Relates to the operating mechanism and circuits by which a number of keys at a transmitting station can operate a number of magnets controlling the action of the levers of a typewriter. 1 claim.

23,960. "An improved electric switch or governor." E. Cros. Dated December 1st, 1899. The switch is opened or closed according to the speed of a shaft. 2 claims.

24,049. "Improved inter-communication telephone system." L. E. Wilson. Dated December 2nd, 1899. Relates to the class of direct call system in which the line from each station is branched to each of the other stations, the call being made by means by means of jacks or switches connected to the line wanted, the home jack or switch having the bell in circuit. Each station is provided with a magnet, the double contact armature of which normally completes a shunt across the secondary of the induction coil, but when excited by a call opens the shunt and closes the circuit of the primary. Separate pairs of stations can converse on independent lines, but an interfering station cannot clear its magnet as the batteries put to the common line would be opposed. 1 claim.

24,231. "A new or improved electrical massage rubbing or brushing apparatus." B. Kellermann and B. Kellermann. Dated December 5th, 1899. Relates to electrica massage apparatus. 1 claim.